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BULLETIN

OF THE

Lowell Textile School

LOWELL, MASS.

Issued Quarterly

1923-1924

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Moody Street and Colonial Avenue

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COMMISSION ON ADMINISTRATION AND FINANCE

CALENDAR.

1923.

September 27, Thursday	Registration.
October 4, Thursday	Registration.
October 8, Monday	Opening of evening school.
October 12, Friday	Columbus Day. No classes.
November 29, Thursday November 30, Friday	Thanksgiving recess. No classes.
December 21, Friday	End of first term.

1924.

January 3, Thursday	Opening of second term.
March 14, Friday	Closing of evening school.
April 9, Wednesday	Graduation.

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Officers.

ARTHUR G. POLLARD, *Chairman.*

ROYAL P. WHITE, *Vice-Chairman.* CHARLES H. EAMES, *Clerk.*

Trustees.

On the Part of the Commonwealth of Massachusetts.
Dr. Payson Smith, Commissioner of Education.

On the Part of the City of Lowell.
Hon. John J. Donovan, Mayor of Lowell.

For Term ending June 30, 1924.

Arthur G. Pollard, Lowell, President, Lowell Hosiery Company.
Royal P. White, Lowell, Agent, Stirling Mills, class of 1904.
Edward A. Bigelow, Worcester, Manager, Hopeville Manufacturing Company, class of 1906.
Herbert Waterhouse, North Chelmsford.
Edward B. Wentworth, Malden, Treasurer, Tremont and Suffolk Mills, Boston corporation, mills at Lowell.

For Term ending June 30, 1925.

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Hugh J. Molloy, Lowell, Superintendent of Public Schools.
T. Ellis Ramsdell, Housatonic, Agent, Monument Mills, class of 1902.
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Joseph A. Gagnon, Lowell, President of The Gagnon Company.

For term ending June 30, 1926.

Frederick A. Flather, Lowell, Treasurer, Boott Mills, Boston corporation, mills at Lowell.
Henry A. Bodwell, Andover, Treasurer and General Manager, Smith & Dove Manufacturing Company, class of 1900.
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Mrs. H. L. Boutwell, 209 Summer Street, Malden, Mass.
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GEORGE PAUL FEINDEL Assistant Instructor in Chemistry.	141 Pawtucket Street.
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EDITH CLARA MERCHANT Evening Instructor in Freehand Drawing.	268 Westford Street.
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JOSEPH LEO CROWLEY Evening Instructor in Freehand Drawing.	252 Methuen Street.
WILLIAM EDWARD DICKINSON Evening Instructor in Design.	50 Eustis Street.
CHARLES HENRY KENDALL Evening Instructor in Design.	115 Mount Vernon Street.
HENRY EARL MCGOWAN Evening Instructor in Mathematics.	36 Varney Street.

THE LOWELL TEXTILE SCHOOL.

EVENING CLASSES.

GENERAL INFORMATION.

Entrance Requirements.

All applicants to the evening classes must understand the English language and simple arithmetic. Those who are graduates of a grammar or high school are admitted upon certificate. Those who cannot present such a certificate are required to take examination in the subjects of English and arithmetic. In the examination in English a short composition must be written on a given theme, and a certain amount must be written from dictation. In the examination in arithmetic the applicant must show suitable proficiency in addition, subtraction, multiplication, division, common and decimal fractions, percentage, ratio and proportion. Opportunity to register or to take these examinations is offered each year, generally on the Thursday evenings of the two weeks previous to the opening of the evening school.

Registration.

Before entering the class a student must fill out an attendance card, which can be obtained at the office or from the instructors in the various departments.

Any student who has filed an attendance card and who wishes to change his course must notify the office before making the change.

Sessions.

The evening classes commence the second Monday of October and continue for twenty-one weeks. The school is open on four evenings each week during the period mentioned, except when the school is closed for holiday recesses.

Supplies.

Students must provide their own books, stationery, tools, etc., and pay for any breakage or damage that they cause.

Student's supplies will be sold from the storeroom every evening school night from 6.45 to 7.15 P.M.

Fees and Deposits.

All evening courses are free to residents of Lowell. To those outside of Lowell the fee is $10 per year for *each course of two nights per week*. Students taking two courses or attending courses requiring more than two nights per week are required to pay $15 per year for three nights and $20 for four nights.

All fees and deposits must be paid in advance.

All students, whether from Lowell or not, taking Course (*a*), Chemistry and Dyeing Department, are required to make a deposit at the commencement of the course, — $5 for first-year students, and $10 for second-year students. A deposit of $10 will be required of all students taking Course (*b*), (*c*) or (*d*). This is to cover the cost of laboratory breakages, chemicals, apparatus, etc., and at the end of the year any unexpended balance is returned, or an extra charge made for the excess breakage.

Every student who takes the chemistry and dyeing course must check up his desk with the instructor of that department when he leaves the school. Any student not doing so will be charged 50 cents.

All students taking Machine-shop Practice will be required to make a deposit of $5. Any unexpended balance remaining at the end of the year will be returned to the student.

Report of Standing.

A report of standing covering the year's work is sent to all students who attend the entire year and take the necessary examinations.

Certificates.

The courses of the evening school are varied and arranged to meet the special needs of those engaged in the industry. They vary in length from one to four years, and at the completion of each course the certificate of the school is awarded, provided, however, that the student has been in attendance in the course during the year for which the certificate is granted.

Schedule of Evening Classes, 1922–23.

	Monday.	Tuesday.	Thursday.	Friday.
Cotton yarns:				
First year	7–9	–	7–9	–
Second year	–	7–9	–	–
Third year	7–9	–	–	7–9
Woolen and worsted yarns:				
First year	7–9	7–9	–	–
Second year	–	7–9	–	–
Third year	7–9	–	–	7–9
Design:				
First year (cotton)	–	–	–	7–9
First year (woolen and worsted)	–	–	7–9	–
Second year (cotton)	7–9	–	7–9	–
Second year (wool)	7–9	7–9	–	–
Third year (cotton)	–	7–9	–	–
Third year (wool)	–	–	7–9	–
Fourth year (cotton)	7–9	–	–	–
Fourth year (wool)	–	7–9	–	–
Cotton weaving	–	7–9	–	–
Woolen and worsted weaving:				
First year	–	–	–	7–9
Second year	7–9	–	–	–
Dobby and Jacquard weaving	–	–	7–9	–
Cotton finishing	–	7–9	–	7–9
Woolen and worsted finishing	7–9	–	7–9	–
Freehand drawing:				
First year	7–9	–	7–9	–
Second and third years	–	7–9	–	7–9
Elementary chemistry:				
First year	7–9	–	7–9	–
Second year	7–9	–	7–9	7–9
Dyeing	7–9	7–9	7–9	–
Analytical chemistry	7–9	7–9	7–9	–
Mechanics	7–8	–	–	7–8
Steam	–	8–9	8–9	–
Strength of materials	–	7–8	7–8	–
Electricity	–	7–8	7–8	–
Mathematics:				
First year	8–9	–	–	8–9
Second year	–	8–9	8–9	–
Shop mathematics	7–8	–	–	7–8
Machine drawing:				
First year	7–9	–	–	7–9
Second year	–	7–9	7–9	–
Third year	–	7–9	7–9	–
First year (engineering course)	–	7–9	–	–
Second year (engineering course)	–	–	–	7–9
Third year (engineering course)	–	–	–	7–9
First year (shop course)	–	7–9	–	–
Second year (shop course)	7–9	–	–	–
Third year (shop course)	–	–	–	7–9
Machine shop:				
First year	–	–	7–9	7–9
Second year	7–9	7–9	–	–

GENERAL EVENING COURSES.

The Lowell Textile School now offers to students several general courses. For each course a definite schedule is arranged which requires attendance of from six to eight hours per week.

The object of these courses is to give young men of ambition an opportunity to obtain instruction in all the branches of science that are allied with their daily work. For example, one who is employed as a weaver in a textile mill may, by means of the courses in manufacturing, obtain knowledge of the manufacture of yarn, the production of a design, and the methods of finishing a fabric, as well as the manner of its weaving or knitting. In like manner the dyer may augment his knowledge of the chemicals and materials he is daily handling. The engineer and machinist may acquire a knowledge of the mathematics, science of mechanics, electricity and drawing that underlie all the work of an engineer.

It is recognized that the interests of such students lie in a particular field of industry, and these courses are designed to bear directly upon the special line, and supplement, as far as possible, the practical work in which the student is engaged during the day.

The student selects his course upon entrance, and continues a regular schedule of subjects for three, four or five years, as may be necessary for its completion.

In a word, any man having a common school education and the ambition to advance in his line may now secure a broad and comprehensive training in the subjects which will be of vital importance to him in obtaining the goal of his ideal.

These general courses are supplemented by partial courses in all the subjects given, so that a student who finds it impracticable to carry on all the subjects in a complete course may select and take such subjects as will be of most value to him in his work.

A student taking one of these courses may attend school during the periods in which the subjects which he selects are being given.

A description of all courses follows.

I. Cotton Manufacturing — 4 Years.

This course includes a study of cottons and the manufacture of cotton yarns from the raw material to the finished yarn, and also a study of plain and fancy weaving. In close connection with the work in weaving is a course in designing which covers the entire field of cotton fabrics. During the latter part of the course a study of cotton finishing is made.

For detailed description of subjects see page 14.

Schedule of Studies.

First Year.

	Monday.	Tuesday.	Thursday.	Friday.
7–9 P.M.	Cotton yarns.	–	Cotton yarns.	Design.

Second Year.

7–9 P.M.	Design.	Cotton yarns.	Design.	–

Third Year.

7–9 P.M.	Cotton yarns.	Design.	–	Cotton yarns.

Fourth Year.

7–9 P.M.	Design.	Cotton finishing.	–	Cotton finishing.

Ia. Cotton Yarns — 3 Years.

This course is intended for those who desire to study the art of cotton yarn manufacture, and includes a study of the commercial varieties of cotton followed by a detailed study of each of the operations used in the manufacture of a cotton yarn.

Instruction is given by means of lecture and demonstration on the machines, and includes the solution of many problems of draft, twist and production.

Demonstration in the laboratory consists of instruction in machine adjustment and a study of the results of different settings, timings, speeds, etc.

For detailed description of subject see page 14.

II. Wool Manufacturing — 4 Years.

This course is arranged to give those engaged in the manufacture of woolens and worsteds instruction in the various branches of the work. It includes a study of wools and allied fibers and the manner of manipulating from fibers to finished fabric, including all the processes of yarn manufacturing, weaving, designing and finishing.

For detailed description of subjects see page 15.

Schedule of Studies.

First Year.

	Monday.	Tuesday.	Thursday.	Friday.
7–9 P.M.	Woolen and worsted yarns.	Woolen and worsted yarns.	Design.	–

Second Year.

7–9 P.M.	Design.	Design.	Woolen and worsted yarns.	–

Schedule of Studies — Con.

Third Year.

	Monday.	Tuesday.	Thursday.	Friday.
7–9 P.M.	Worsted yarns.	–	Design.	Woolen and worsted yarns.

Fourth Year.

	Monday.	Tuesday.	Thursday.	Friday.
7–9 P.M.	Woolen and worsted finishing.	Design.	Woolen and worsted finishing.	–

IIa. Woolen Yarns — 2 Years.

IIb. Worsted Yarns — 3 Years.

In both courses the students of the first year pursue the same class work, covering instruction in the many kinds of wool, the varying properties of the fibers, trade terms, sorting, scouring, carbonizing, etc. This work is followed by instruction in carding and mule spinning for the woolen students. For those desiring to study worsted yarn manufacture work is taken up on the worsted card, followed by gilling and combing and processes of top making. The last year of this course is devoted to a study of worsted yarn manufacture on both the English and French systems.

Thus in three years' time one may acquire a thorough course of instruction in worsted yarn manufacturing, or, in two years, a knowledge of woolen yarn manufacture. He is thus able to obtain a knowledge of machines and processes that could not be obtained in the ordinary course of events in the mill.

For detailed description of subjects see page 15.

IIIa. Cotton Design — 3 Years.

IIIb. Woolen and Worsted Design — 3 Years.

For one who is working in the design, pattern or weave room, the courses in design offer instruction in the great variety of weaves, in cloth construction and analysis. It is practically impossible, under ordinary circumstances, for one to acquire in the mill a knowledge of the construction of the many textile fabrics. Where a person spends the greater portion of his life in one or two mills, his knowledge of fabrics is confined to those made in the mills in which he works. A course in designing supplements the experience received during the day, thus broadening a person's textile knowledge as well as making him better acquainted with the fabrics upon which he works daily.

For detailed description of subjects see page 16.

IIIc. Freehand Drawing — 3 Years.

In the course in freehand drawing, instruction is given in the drawing from models, casts and designs. Work is taken up in charcoal and also in colors. This course has appealed to many young women of the city, and it is believed that this is a most fortunate opportunity for both young women and young men of Lowell to acquire the elements of artistic designing.

IVa. Elementary Chemistry — 2 Years.

General Chemistry, including Inorganic and Organic.
Qualitative Analysis.

IVb. Textile Chemistry and Dyeing — 3 Years.

Lectures in Textile Chemistry and Dyeing.
Laboratory Work in Dyeing.

IVc. Analytical Chemistry — 3 Years.

Laboratory Work and Lectures in Qualitative Analysis.

IVd. Textile and Analytical Chemistry — 4 Years.

Lectures in Textile Chemistry and Dyeing.
Laboratory Work in Analytical Chemistry.

Hardly any branch of applied science plays so important a part in our industrial world as chemistry. Many large mills employ the chemist as well as the dyer, and with the great progress which is being made in the manufacture and application of dyestuffs, a basic knowledge of chemistry becomes an absolute necessity to the dyer. Within a comparatively short distance from Lowell are establishments employing men who require some knowledge of chemistry but who may not necessarily use dyes. Some find a knowledge of analytical chemistry helpful in their everyday work.

To meet these varying needs of our industrial community, the school offers a two-year course in general chemistry, organic and inorganic, which may be followed by any one of three courses, viz., textile chemistry and dyeing, analytical chemistry, and textile and analytical chemistry. In order to take Courses IVb, IVc or IVd, candidates must have a certificate from Course IVa, or show by examination or approved credentials that they have taken the equivalent of the work covered by this course.

For detailed description of subjects see page 17.

Va. Cotton Weaving — 1 Year.

Vb. Woolen and Worsted Weaving — 2 Years.

Vc. Dobby and Jacquard Weaving — 1 Year.

These are called weaving courses, but in reality they might more properly be called courses in loom fixing, for particular attention is given to the mechanism of the looms, the timing of the various parts, and the adjustments possible to produce desired results. Here, again, is an opportunity for students to fix, dismantle, erect and adjust looms in a way that could not be tolerated in any mill. Frequently students come to the classes with the knowledge that certain adjustments must be made upon a loom if certain results are to be obtained, but the reason for these is not known. The school offers the machine, time and instructor in order that the weaver or loomfixer may determine for himself the reason for some rule which he practices in his daily work. Not only can he become more familiar with the loom upon which he works every day, but he can study the operations of many other makes of looms.

For detailed description of subjects see page 17.

VIa. Engineering Course — 3 Years.

This course has been arranged with the object of offering to those engaged in the mechanical and electrical departments of our mills opportunities to learn something concerning the theory underlying the many practical methods which they pursue during the day.

The course in the first year is laid out to include the fundamental subjects upon which all engineering rests, — mathematics, mechanics and mechanism of machines, and mechanical drawing. This elementary work is then strengthened by an additional year of mathematics and by two more years of drawing. Strength

of materials is included in the second year, while the major portion of the third year's work is devoted to a consideration of the elements of steam and electrical engineering.

For detailed description of subjects see page 19.

Schedule of Studies.

First Year.

	Monday.	Tuesday.	Thursday.	Friday.
7-8 P.M.	Mechanics.	Mechanical drawing.	–	Mechanics.
8-9 P.M.	Mathematics.	Mechanical drawing.	–	Mathematics.

Second Year.

7-8 P.M.	–	Strength of materials.	Strength of materials.	Machine drawing.
8-9 P.M.	–	Mathematics.	Mathematics.	Machine drawing.

Third Year.

7-8 P.M.	–	Electricity.	Electricity.	Machine drawing.
8-9 P.M.	–	Steam.	Steam.	Machine drawing.

VIb. Mechanical Drawing Course — 3 Years.

For one having occasion to make a sketch or detail drawing for the purposes of illustration or instruction, or for one who is daily required to work from a drawing or blue print, the course in mechanical drawing is offered. It first lays a foundation of the principles of mechanical drawing, and follows this with two years' work in drawing directly from parts of machines, preparing both the detail and the assembly drawing.

For detailed description of subject see page 19.

VId. Machine Shop Course — 3 Years.

The first year of this course is spent upon subjects which will prepare the student to more readily assimilate and appreciate the real work in the shop itself. Hence a large part of the first year's work is devoted to the mechanics and mechanism of machines, so that the student will be familiar with the principles used in transmitting force and motion in the machine tools upon which he spends most of his time during his second and third years. Since the ability to read and interpret a drawing is an elementary requirement of every machinist, it is required that a portion of each of the three years be devoted to that subject.

Thus it becomes possible for one who may be working at the bench during the day to learn how to operate a lathe or other tool, or for a lathe hand to acquire a knowledge of a planer, shaper, milling machine, grinder, etc. A man who has a knowledge of the special machine which he operates may by means of this course become a more intelligent machinist. He should supplement this course with the courses in mechanical drawing and mechanism, in order that his training for an all-round machinist or mechanic may be more complete.

For detailed description of subjects see page 20.

Schedule of Studies.

First Year.

	Monday.	Tuesday.	Thursday.	Friday.
7-8 P.M.	Mechanics.	Mechanical drawing.	–	Mechanics.
8-9 P.M.	Mathematics.	Mechanical drawing.	–	Mathematics.

Second Year.

7-8 P.M.	Machine drawing.	–	Shop practice.	Shop practice.
8-9 P.M.	Machine drawing.	–	Shop practice.	Shop practice.

Third Year.

7-8 P.M.	Shop practice.	Shop practice.	–	Machine drawing.
8-9 P.M.	Shop practice.	Shop practice.	–	Machine drawing.

VIIa. Cotton Finishing — 1 Year.

VIIb. Woolen and Worsted Finishing — 1 Year.

In these courses machine work is supplemented by lectures and discussions pertaining to the many finishes given to fabrics. The action of soaps, water, steam, heat and cold upon cloth containing one fiber or combinations of fibers as used in commercial fabrics is carefully studied. These courses also help the finisher to broaden his knowledge of textile fabrics.

For detailed description of subjects see page 21.

SUBJECTS OF INSTRUCTION.

COTTON DEPARTMENT.

Cotton Yarns.

Instruction is given by means of lecture and demonstration. The outline of the course is as follows: —

Fiber. — Before taking up the details of the operation of manipulating the fiber into yarn, a careful study is made of the characteristics and classification, both botanically and commercially, of the many varieties of the cotton fiber. Methods employed in cultivating, marketing, grading and stapling are considered, and under these heads a detailed study is made of the types of gin employed.

Opening and Picking. — Instruction in the preliminary operation of opening and picking covers the mechanical construction of the machines, their parts and adjustments, as fully as the manufacturing results accomplished by the machines. This includes such construction details as evener, lap measuring and safety stop motion, grids, cleaning trunks, beaters, etc.; also operation details which involve the adjustment of waste, drafts and character of laps.

Carding. — The process of carding is considered one of the most important, and proper time is devoted to the construction and operation of cards that the student may be familiar with the various parts of the card and the function and design of each. The construction and application of card clothing, as well as the methods of grinding, form a part of the work.

Drawing. — Under this head is taken up the theory of doublings and their effect upon the quality of roving and yarn. Like previous and subsequent processes the machine construction forms an important part of the work. Proper stress is paid to such subjects as stop motions, drawing rolls and their covering, cleaners and evener motions.

Roving Processes. — Under this head are studied the various machines known as the slubber, intermediate, fine and jack fly frames. The relative motion of the various parts of these machines is so complex that a good opportunity is here presented to fix in the student's mind the application of certain mechanical principles that are used in other departments and upon other machines in the manufacture of textile material. With each process of yarn manufacture are explained the systems of sizing and numbering, and under this head are taken up both the metric and English systems.

Ring Spinning and Twisting. — The consideration of spinning yarn by the ring frame method involves a knowledge of the uses to which the yarn is to be put, subsequent methods of handling that proper roving may be selected, suitable amounts of draft and twist provided, correct size of rings and travelers selected, building motions suitably adjusted, etc. The operation of twisting yarns is so closely related to spinning by the ring method that it is studied at the same time. This opens an almost limitless field of novelty yarn manufacture, and offers a very good opportunity to derive new types of yarn or new mechanism to produce the effects. Yarn defects are studied with reference to the cause and remedy.

Mule Spinning. — This method of spinning is very different from that of the ring frame, and the mechanical details are more complicated. The student is furnished with new means of producing yarns, and can compare the relative advantage of each method. A thorough understanding of mule spinning is perhaps more a study of mechanical motions and their functions. This results almost invariably

in assisting the student to understand previous processes and machines better because of his work on the mule. It is the object to make clear to the student's mind the principles underlying the construction and operation of the parts that control the drawing, twisting, backing off, winding, together with such special motions and devices as are used upon the modern mule.

Combing. — This process is explained by lecture work and by operation and assembling of the various types of combs in service in the laboratory. The object of combing is fully considered, and the different means employed on the many types of combers on the market are studied. This includes such types as the Heilman, New Whitin and Nasmith combers.

WOOLEN AND WORSTED DEPARTMENT.

Woolen and Worsted Yarns.

Raw Materials. — A study of raw materials which enter into the manufacture of woolen or worsted yarns, or are made into yarns by processes similar to those employed in the manufacture of woolen and worsted yarns, would include silk, mohair, alpaca, vicuna, cashmere, camel's hair and cotton. In connection with these are considered shoddy, noils and extracts.

Wool Sorting. — Familiarity with the various grades and kinds of wool is obtained by lecture. The various characteristics and properties are explained, as are also trade terms, such as picklock, XXX, XX, $\frac{1}{2}$-blood, $\frac{3}{8}$-blood, $\frac{1}{4}$-blood, delaine, braid, etc. Some skill is acquired in the estimation of shrinkage and in judging the spinning qualities.

Wool Scouring. — The object of scouring and the methods employed are explained, and this involves the consideration of the soaps and chemicals used in washing; also the waste products and their utilization. Actual work is done in scouring a commercial quantity of wool by machines that are made similar in operation to regular commercial machines. A study is made of the effect of the hardness of water upon soap. At the same time the use of driers, their operation and regulation, is taken up, and the methods of carbonizing wool, noils, burr waste, rags, etc., are studied and explained.

Burr Picking, Mixing, Oils and Emulsions. — The use of burr pickers in cleaning wool and the use of mixing pickers in making color blends is covered by lecture and demonstration. Under the subject of oil and emulsions are taken up the characteristics of various oils and the means employed to test them.

This work is taken only by those students who are pursuing the Woolen Manufacturing Course.

Carding. — The different systems of carding wool, depending on whether it is to be made into woolen or worsted yarns, are fully explained, as is also the construction, setting and operation of cards. A part of this work consists of a study of card clothing, its construction, application and grinding.

Woolen Mule. — The student studies thoroughly the operation of the mule as a whole, and acquaints himself with the various principal mechanisms, as, for example, the backing off and winding motions, the quadrant, builder-rail, faller regulation, etc.

Top Making and Combing. — This branch takes up, besides the carding of the wool on a worsted card, the preparing processes, backwashing, also gilling of the stock before and after combing. The construction of the gill boxes and combs is studied by lectures. Later, quantities of stock are made into top and then into yarn.

The Noble, Lister and French combs are studied, and the various calculations to determine draft, noiling, productions, etc., are made.

Drawing and Spinning. — The equipment in the laboratory offers opportunity to make worsted yarn by either the Bradford or open drawing system or by the French system. The process includes the various machines in the successive steps of making Bradford spun yarn, and the functions of the different machines are studied. In the latter, or French system, the stock is run through the drawing

machines, and the roving spun into yarn on the worsted mule. The same method of studying the mechanism and operations of these machines is followed as in the case of previous methods of instruction. The student by pursuing this course can compare the different methods of yarn manufacture and note the results of each.

With the instruction in spinning by the Bradford system is given work on the twisters and the effects that may be produced.

TEXTILE DESIGN AND WEAVING DEPARTMENT.

Textile Design.

During the first year instruction is given in the subject of classification of fabrics, use of point or design paper, plain fabrics, intersection, twills and their derivation, sateen, basket and rib weaves, checks and stripes, fancy weaves, including figured and colored effects; producing chain and draw from design, and *vice versa;* extending and extracting weaves.

For Cotton Goods.

During the second year consideration is given to fancy and reverse twills, diaper work, damasks, skip weaves, sateen fabrics with plain ground, backed fabrics, and multiple ply fabrics. Students are required to make original designs. Special attention is given to the consideration of color effects.

The analysis of these fabrics forms a part of the course in design. This also includes the necessary calculations required to reproduce the fabric or to construct fabrics of similar character.

For Woolen and Worsted Goods.

During the second year the instruction given includes warp and filling backed cloth, figured effects produced by extra warp and filling, double cloths, multiple ply fabrics, cotton warps, blankets, bath robes, crêpes, filling reversible, Bedford cords, imitation furs, crêpons, matelasse and imitations, double plain, ingrains, velvets, corduroys, overcoatings, trouserings.

The analysis of these fabrics, together with the consideration of the shrinkages and dead loss in all fabrics, theory of diameter of yarns, and costs of mixer blends, is a part of this course.

The advanced work takes up the more complicated weaves adapted to harness work, and leads into leno and Jacquard designs. The following is a brief list of the subject heads, which will give some idea of the course: double plain cloths, ingrains, tricots, chinchilla, tapestry, blankets, upholsteries, spot weaves, pile or plush, crêpon, matelasse and its imitations, piqué, marseilles, quilting and miscellaneous designs for Jacquard, leno, fustian, tissue fabrics and lappets.

Cloth Analysis.

In the first year this subject takes up in a systematic manner the analysis of samples illustrating the various cloth constructions for the purpose of determining the design of the weave and the amount and kind of yarns used, and forms the basis of calculation in the cost of reproducing any style of goods. The various topics discussed are reeds and setts; relation and determination of counts of cotton, woolen, worsted, silk and yarns made from the great variety of vegetable fibers; grading of yarns, folded, ply, novelty and fancy yarns; application of the metric system to yarn calculation; problems involving take-up, average counts, determination of counts of yarn, and weight of yarn required to produce a given fabric.

Cloth Construction.

The work includes the application of the different weaves and their combinations in the productions of fancy designs, both modified and original; the calculation involved in the reproduction of standard fabrics changed to meet varying conditions of weight, stock, counts of yarn and value.

Instruction in this subject, which is given by classroom work, is intended to bring together the principles considered under the subject of design, cloth construction, weaving and yarn making of previous years, and to show the bearing each has in the successful construction of a fabric.

Power Weaving.

Instruction in cotton weaving is carried on upon power looms in connection with the work in Textile Design and Cloth Analysis. This includes a study of the preparation of warps, beaming, dressing, sizing, drawing-in and making of chains, the cutting and lacing of cards, spooling and quilling and the machinery for the same. A study is made of warpers and sizing machines, both for cotton and woolen. Lectures are given to correspond with the progress of the student in the Power Weaving Laboratory covering the following subjects: loom adjustments, chain building, shuttle changing looms, dobby looms, single and double acting dobbies, handkerchief motions, leno weaving, center selvedge motions, filling changing looms, oscillating reeds, lappet motions, various shaker motions, towel and other pile cloth weaving, Jacquard looms, single and double lift leno Jacquards, Jacquards of special design, tying up Jacquard harness. Instruction is also given in weaving on fancy woolen and worsted looms.

CHEMISTRY AND DYEING DEPARTMENT.

General Elementary Chemistry (Inorganic and Organic Chemistry).

Instruction in Elementary Chemistry extends through two years, and includes lectures, recitations and a large amount of individual laboratory work upon the following subjects: —

Theoretical Chemistry. — Chemical action, chemical combination, combining weights, atomic weights, chemical equations, acids, bases, salts, Avogadro's law, molecular weights, formula, valence, periodic law, etc.

Non-metallic Elements. — Study of their occurrence, properties, preparations, chemical compounds, etc.

Metallic Elements. — Study of their occurrence, properties, metallurgy, chemical compounds, etc.

The students take up, as thoroughly as time will permit, the qualitative detection of the more common metals and non-metals, with practical work.

This work, although necessarily elementary, is intended to prepare the student to more understandingly study the manufacture of dyestuffs, and coal tar colors in the more advanced courses which follow.

Qualitative Analysis.

The laboratory work during the second year of the Elementary Chemistry course consists entirely of Qualitative Analysis. While this course is necessarily taken up in an abbreviated and elementary manner, it is so arranged that the students may become familiar with the separations and the detections of the common metals and acids. This course is also preliminary to the work given in Analytical Chemistry.

During the first year of the Elementary Chemistry course most of the time will be devoted to the non-metals and theoretical chemistry, and the laboratory work will be briefly upon the non-metals.

During the second year the classroom work will be upon metals and the hydrocarbons and their derivatives, and the laboratory work will be qualitative analysis.

Textile Chemistry and Dyeing.

The outline of the lecture course given in Textile Chemistry and Dyeing is as follows: —

Technology of Vegetable Fibers. — Cotton, linen, jute, hemp, china grass. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Animal Fibers. — Wool, mohair, silk. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Artificial Fibers. — Study of the various forms of artificial silk, the process of manufacture, their properties and action with chemicals, acids and heat.

Operations preliminary to dyeing. — Bleaching of cotton and linen; wool-scouring; bleaching, fulling and felting of wool; carbonizing; silk-scouring and bleaching; action of soap.

The bleaching of cotton is studied with description of the various forms of kiers and machinery used; also the action of the chemicals used upon the material, and the various precautions that must be taken in order to insure successful work.

Under this heading is included a study of the reagents used in the emulsive wool-scouring process, and their action upon the fiber under various conditions; also the most successful of the solvent methods for degreasing wool.

Water and its Application in the Textile Industry. — Impurities present methods for detection, their effect during the different operations of bleaching, scouring, dyeing and printing, and the methods used for their removal or correction.

The important subject of boiler waters is also studied under this heading, with a full discussion of the formation of boiler scale, its disastrous results, and the methods by which it may be prevented.

Mordants and Other Chemical Compounds used in Textile Coloring, and classified as Dyestuffs. — Theory of mordants, their chemical properties and application, aluminum mordants, iron mordants, tin mordants, chromium mordants, organic mordants, tannin materials, soluble oil, fixing agents, leveling agents, assistants, and numerous other compounds not dyestuffs that are extensively used in the textile industry.

Under this heading are included the definitions of various terms and classes of compounds used by textile colorists, such as color lakes, pigments, fixing agents, developing agents, mordanting principles and leveling agents.

Natural Organic Coloring Matters. — Properties and application of indigo, logwood, catechu or cutch, Brazil wood, cochineal, fustic, turmeric, madder, quercitron bark, Persian berries, and other natural dyestuffs that have been used in recent years by textile colorists.

Mineral Coloring Matters. — Under this heading are discussed the properties of such inorganic coloring matters and pigments as chrome yellow, orange and green, Prussian blue, manganese brown, iron buff.

Artificial Coloring Matters. — General discussion of their history, nature, source, methods of manufacture, methods of classification and their application to all fibers.

Special study of basic coloring matters, phthalic anhydride colors, including the eosins and phloxines; acid dyestuffs, Janus, direct cotton, sulphur and mordant colors, including the alizarines and other artificial coloring matter requiring metallic mordants; mordant acid and insoluble azo colors, developed on the fiber; reduction vat colors, aniline black and other artificial dyestuffs not coming under the above heads.

As each class of dyestuffs is taken up the details of the methods of applying them upon all the different classes of fabrics and in all the different forms of dyeing machines are thoroughly discussed; also the difficulties which may arise in their application, and the methods adopted for overcoming them.

Machinery used in Dyeing. — A certain amount of time is devoted to the

description of the machinery used in the various processes of textile coloring, which is supplemented as far as possible by the use of charts, diagrams and lantern slides.

During the third year of this course, if time permits, the more advanced subjects of union dyeing, textile printing, dye testing, color matching and color combining will be briefly considered.

Dyeing Laboratory.

Besides lectures and recitations upon the subject of Textile Chemistry and Dyeing, practical laboratory work is required. By the performance of careful and systematic experiments the student learns the nature of the various dyestuffs and mordants, their coloring properties, their action under various circumstances, and the conditions under which they give the best results. The more representative dyestuffs of each class are applied to cotton, wool and silk, and each student is obliged to enter, in an especially arranged sample book, a specimen of each of his dye trials with full particulars as to the conditions of experiment, percentage of compounds used, time, temperature of dye bath, etc.

For convenience and economy most of the dye trials are made upon small skeins or swatches of the required materials, but from time to time students are required to dye larger quantities in the full-sized dyeing machines.

Analytical Chemistry.

The object of this course will be to give the student a general idea of the underlying principles of Analytical Chemistry, with a sufficient amount of laboratory work to enable him to become proficient in performing the ordinary routine analysis of the textile plant. Frequent recitations will be held for the discussion of methods and the solution of stoichiometrical problems.

The work covered the first two years is based on Smith's "Quantitative Analysis," and for the advanced work, consisting of the analysis of soap, water, oils, cloth and other materials of particular interest to the textile chemist, Griffin's "Technical Methods of Analysis" is used as a text.

TEXTILE ENGINEERING DEPARTMENT.

Mechanics and Mechanism.

Under this heading are considered the principles which underlie the transmission of force and motion. After discussing units of measurement, such mechanical principles as are exemplified by the jackscrew, pulley block, lever, worm and wheel, wedge, wheel and axle, and differential pulley are studied. This is followed by instruction relative to the design and layout of pulleys, belting, gears and gearing, etc. Shop mathematics is a prerequired subject.

Strength of Materials.

This subject deals with the topic in such a way as to make the knowledge valuable and practical to a man engaged in machine, mill or building design. It relates to the proper stresses allowable in ordinary materials of construction, and the design of beams, columns, etc., to safely carry loads.

Mechanical Drawing (Course VIb).

The work in this subject is so laid out that at its completion a man shall be thoroughly familiar with the making of a working or shop drawing. After a study of the underlying principles of projections and instruction in penciling, inking, lettering and tracing, the subject of sketching and the making of detail drawings therefrom is especially stressed. The preparation of assembly drawings is finally considered. Shop mathematics is a prerequired subject.

Mechanical Drawing (Courses VIa-VId).

The work required in this subject follows the same plan as described for Course VIb. Although the time allotted to this subject is only one-half that given in Course VIb, nevertheless the student acquires a good knowledge of the fundamentals of mechanical drawing.

Steam.

The instruction in this subject covers, so far as time permits, the elements of steam engineering. The topics covered are heat and its measurement, use of steam tables, types of boilers, engines and turbines, boiler and engine room accessories, together with a study of the methods of testing the various types of apparatus. Actual tests on such equipment are made as the size of the class permits.

Electricity.

This subject deals entirely with the theory and application of direct currents. The main topics treated are —

Magnetism.
Theory of electric currents.
Direct current generators and motors.
Measuring instruments.
Simple alternating current circuits.
Wiring.
Transmission.

Mathematics — First Year.

This subject is a continuation of the work in Shop Mathematics, and is intended as a foundation for the advanced courses in engineering. Some of the topics treated are —

Elementary algebraic operations of —
- Addition.
- Subtraction.
- Multiplication.
- Division.

Factoring.
Fractions.
Lineal equations.
Theory of indices.

Mathematics — Second Year.

Before taking this subject it is advisable that the student should be well grounded in the essentials of plane geometry. A general outline of the subject follows: —

Graphical representation.
Logarithms.
Slide rule.
Quadratic equations.
Simultaneous quadratics.
Binomial theorem.
Theory of equations.
Trigonometry.

Shop Practice.

This subject is covered by a series of lectures on care and management of machine-shop tools leading up to the actual operation of the same.

Among the exercises taken up by the student are bench work, tool grinding and tempering, straight and taper turning, thread cutting, drilling and boring, planer work, milling machine work, gear cutting, etc.

Shop Mathematics.

The purpose of this subject is to give instruction in the practical application of arithmetic, geometry and algebra to everyday problems, and the topics which are covered are, briefly, addition, subtraction, multiplication, division, common and decimal fractions, ratio and proportion, common areas and volumes, and simple equations involving one unknown.

FINISHING DEPARTMENT.

Woolen and Worsted Finishing.

The outline of this course, which is given chiefly by means of lecture work, is as follows: —

Burling and Mending. — Under this head are taken up for consideration the examination of flannel as it comes from the loom; the construction, use and location of the perch; the methods used in marking defects, measuring, weighing and numbering of cloths; also the methods of inspection for fancies, single cloths and double cloths. The object of burling, mending and the types of tables employed, the method of removing knots, runners, etc., the object of back shearing and the use of burling irons, the replacing of missing threads and the importance of sewing as a part of the finishing process, are all considered in detail. The removal of oil and tar spots as well as stains of various kinds is studied.

Fulling. — This branch covers a study of the conditions of the flannel as it comes from the loom, and the influence of oil, etc., upon the procedure. Considerable time is devoted to the various methods of producing a felt, the early types of stocks, hammer falling and crank stocks, and their modifications and development into the present type of rotary fulling mills of both the single and double variety. The details of construction in all machines are carefully taken up and include the design and composition of the main rolls, methods of covering, regulation and means of adjusting the pressure of traps and rolls, consideration of the shoes, the use and regulation of the various types of stop motion, the different types of stretchers, guide rolls and throat plates.

The theory of felt is taken up and the influence of pressure, moisture, heat, alkali and acid is considered, as well as the hydroscopic and felting properties of different wool fibers. The preparation of the flannel for the mill and the usual methods of determining shrinkages, as well as the various methods of soaping, are given careful attention. The preparation of various fulling soaps and the value of each for the production of various degrees of felt, as well as the determination of the proper amount of alkali for various goods, are carefully studied and demonstrated. The manipulation of the various kinds of goods in the mill, viz., all wool, shoddies and mixed goods, is studied in classroom and by operation in the mill.

The change in weight and strength for each operation is carefully considered, as is also the value of the flocks made in each. A study of the various methods of flocking, such as dry and wet, is considered in both class and machine rooms. In each operation the defects likely to materialize are studied, as well as the cause thereof, and various methods of modifying or lessening them.

Washing and Speck Dyeing. — This branch considers the scouring, rinsing and washing of goods both before and after the fulling process; the various types of washers; and the details of construction, such as suds box, rolls, etc. The theory of scouring, uses of Fuller's earth, salt solutions and sours on the different kinds of goods are made clear by practical work in the machine room, where the effects due to improper scouring, such as stains, cloudy effects, wrinkles and unclean goods, are demonstrated. The discussion of the necessity of speck dyeing follows naturally from the study of these matters, and includes methods of preparation, materials used, application and tests required.

Carbonizing. — This is an important branch of finishing, and includes a study of the various carbonizing agents, methods of application, strength of solutions and neutralizing, as well as the machines used. Stains and imperfections resulting from carbonizing are also considered. The drying and tentering machines and extractors employed are taken up at this point.

Gigging, Napping and Steaming. — The construction in detail of the various types of gigs, nappers, steamers, wet gigs, rolling, stretching, crabbing and singeing machines is discussed, and their actions upon the cloth and the results obtained are explained.

Various methods of obtaining luster and the production of permanent finish are considered in connection with steaming and sponging.

Brushing, Shearing and Pressing. — This includes, as do the other branches, a careful treatment of the machine employed, the preparation of the cloth for each process, the action of each machine in producing its part of the resultant effect. In manipulation of the shear consideration is given to its setting, grinding and adjustment. With the brushing machine the effect of steaming and moisture upon the luster and feel of the goods is shown. A study of the action of the presses, both plate and rotary, involves consideration of pressure, steaming, etc. Special processes to obtain particular effects are taken up, and the part played by each machine is explained. The details involved in handling cloth on a commercial scale, as, for example, measuring, weighing, ticketing, numbering and rolling, are also explained. The necessary calculation and the methods of finishing all grades of goods are considered from time to time during the year.

Cotton Finishing.

The outline of the course in the finishing of cotton fabrics is as follows: —

Cloth Room. — Instruction of the various goods and the object thereof; construction of the various types of inspecting and trimming machines.

Shearing. — The object. A consideration of the various types of shears for treating one or both sides at the same time; also the use of the usual cleaning devices, such as emery, sand and card rolls, beaters and brushes; grinding and the adjustment of the various parts.

The use of brushing and cleaning machines, rolling devices and calender attachments for gray goods.

Singeing. — Developing and object of singeing; the construction of singers of all types, and for various purposes; the use of cooling tanks, steaming devices, rolling and brushing attachments.

Regulation of the flame for various goods, and adjustment of the parts; gas and air pressure, water-cooled rolls; the effect of moisture on the cost of singeing; the use of dry cans in connection with singeing; electric singeing.

Washing. — Open width and string washers, their construction and operation; soaps, temperature, squeeze rolls; washing of various goods and the object thereof; stains.

Napping. — The object of napping and the usual method of treating goods; various types of nappers, single and double acting; felting nappers; construction, grinding and adjustment of various types.

Water Mangles. — Their object and the construction of various types; various rolls, — iron, husk, etc.; scutchers, their object and constructions.

Starch Mangles. — The object and construction of all types of starch mangles for pure starch and filled goods; various types of rolls, — brass, rubber, wood; action of doctor blades, etc.; regulation and object of pressure.

Methods of starching and finishing all standard goods, also a consideration of the various substances used, such as starch, softener and fillers; the preparation of starch and various methods of application.

Dryers and Stretchers. — Both horizontal and vertical, tenter frames, clips; the swing motion and the finishes thus produced; construction; spraying machines, belt stretchers, button breakers; their object and construction.

Calenders. — The object and construction of all types, including the regulation of pressure and nips for the production of various finishes; various types of rolls and their uses, — steel, husk and paper; the use of hot and cold rolls; chasing, friction, embossing and Schriner calenders and the various finishes produced by each; production of watered effects; beetling machines.

Making up room, — yarding, inspecting; different types of folds; pressing, papering, marking.

OLNEY CHEMICAL ALUMNI OF THE LOWELL TEXTILE SCHOOL.

This association was organized in 1908 for the purpose of keeping its members in closer relationship with each other and with the school.

The membership consists of evening graduates from any of the advanced courses in chemistry and dyeing of the Lowell Textile School, and is composed of one hundred and fifty members at present.

The annual meeting is held during the winter months, and the annual reunion is held the third Saturday of June at a place selected by the Board of Control.

Officers.

President, Henry D. Grimes, Lawrence, Mass.
Vice-President, Henry K. W. Torpey, Lowell, Mass.
Secretary and Treasurer, Reginald C. Atkinson, Lowell, Mass.

Board of Control.

Alfred Peever, Methuen, Mass., three years.
Samuel Stott, Lowell, Mass., three years.
Albert Blades, Lowell, Mass., two years.
Winthrop Bean, Lowell, Mass., two years.
George Stewart, Lowell, Mass., one year.
William F. Brandy, Lawrence, Mass., one year.

This association will offer each year a book prize to the evening graduate who attains the highest standing in any one of the advanced courses of the Chemistry and Dyeing Department.

For information regarding this association please apply to Reginald C. Atkinson, 59½ South Whipple Street, Lowell, Mass.

The winner of this prize for 1923 was Maurice D. Frazee, Lowell, Mass.

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BULLETIN

OF THE

Lowell Textile School

LOWELL, MASS.

Issued Quarterly

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Moody Street and Colonial Avenue

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PRESENT DYESTUFF SITUATION IN AMERICA.

Several months ago there was published in the Lowell Courier Citizen an interview with Professor Louis A. Olney, Head of the Chemistry and Dyeing Department of the Lowell Textile School, in regard to the Domestic Dye Situation. Because of its accuracy and expressions of an unbiased nature it received much favorable comment from the press in general and we believe that through this bulletin many will have an opportunity to gain the information which was given in that interview.

The first attempt to manufacture coal tar dyes in this country was made as early as 1868, and during the next ten years developments along this line were of such a nature that it looked as though the manufacture of coal tar colors might become one of the prominent industries of the country. However, owing largely to an unsatisfactory protective tariff and keen and oftentimes unscrupulous foreign competition, the industry from that time on had a very uncertain, and for the most part, unsatisfactory career.

At the outbreak of the war in 1914, several concerns were manufacturing dyes in this country, but these dyes were for the most part made from so-called intermediates which were in turn manufactured in Germany. The supply of these was soon cut off and the American dyestuff industry was placed in a position far worse than it had been for twenty years previous. In spite of this fact, American chemists and dyestuff manufacturers with almost unprecedented activity turned their attention to the development of the industry upon a purely American foundation, and in the last few years have developed it to a point where today there are but few of the important dyes that are not satisfactorily made here and, with the exception of a few special colors, the American textile industry is at the present self-contained as far as dyestuffs are concerned and would be able to run almost indefinitely without importations from abroad.

At first the quality of some of the American made dyes was not all that might have been desired, but as time went on the processes of manufacture were improved and today most of the dyes made in this country are of a quality equal in every respect to imported German dyes and in a number of instances American textile manufacturers have pronounced some of these dyes to be much better than the same product obtained from abroad before the World War.

Few people realize that even at the present time there is an organized attempt to discredit the achievements of the American dyestuff industry, and in a more or less insidious way it has extended to various branches of our Government. The attempt to disrupt the whole plan of the "Chemical Foundation," an organization authorized by the Government during the war for handling German dye and chemical patents, is still pending before the courts, and is a typical illustration of the activities along these lines which are apparently being led by foreign interests and importers of foreign dyes. It is believed, however, that the recent investigation on the part of one of the Senate Committees has, to a considerable degree, enlightened Congress in regard to the absolute falsity of the many charges which were made concerning the Chemical Foundation and American dyestuffs manufacturers.

Owing largely to this propaganda, which was most active when the section of the tariff on dyes was being considered in Congress, the measure was greatly modified to the disadvantage of the dyestuffs manufacturers. The invasion of the Ruhr Valley by the French, however, has had some tendency to counteract the unfavorable features of the tariff, because the German dye industry is largely dependent on raw materials and intermediates which are manufactured in this

district. The unsettled industrial situation in Germany has also had a tendency to interfere with the manufacture as well as to curtail temporarily the exportation of dyes from Germany.

The American Association of Textile Chemists and Colorists has recently become quite an important factor in the color industry of the United States. As an organization it stands more or less between the user of dyes on the one hand and the manufacturer on the other. In less than two years this organization has grown to a membership of over 500 with well organized local sections in Boston, Providence, New York and Philadelphia. When we consider that to become a member of this national association one must have had at least five years of actual experience along the lines of textile chemistry and the application of dyes, and must at the time of election be actively engaged in the coloring industry, the standing and influence of this organization will be understood. This association is at the present time conducting well organized investigations and research work in regard to fastness of dyes and methods of testing, and there will soon be presented for official acceptance a series of standards and tests which will be more scientific and complete than any which have heretofore been formulated.

When the general public buys dyed textile material of any kind, and finds it to be unsatisfactory as far as the fastness of the colors is concerned, the trouble may be assigned to one of three reasons.

1. The demand on the part of the public for colored goods the production of which with the fastest dyes would make them so costly as to be unaccepted by a large proportion of the prospective buyers.

2. The improper choice of dyes on the part of the manufacturer; in other words, using dyes for certain purposes for which they were never intended and for which some better dye could have readily been substituted.

3. The lack of proper dyestuffs or a poor quality of the dyes on hand. Of these causes, the first two are the foremost while the last is almost negligible at the present time. In this connection it might also be interesting to note that some of the unsatisfactory results in dyeing often attributed to American dyes, when followed up, were found to have been produced with German dyes. The American people can do much to help the American color industry by withholding criticism until they are actually certain that it is justified. Criticisms which might have been justified five or six years ago are almost entirely without foundation at present. The store clerk who today says, "We cannot stand behind these colors because they are American made," is misleading the public either through ignorance or intention. As far as the American dyestuffs manufacturer is concerned there is no reason why dyed materials should not be as fast today as they were before the war.

As a result of exhaustive research, and untiring efforts on the part of American chemists, the domestic dyestuffs industry has reached a point in development where it is not only able to provide from 80 to 90 per cent of our own requirements but also has considerable surplus production for exportation. In fact, the future success of this industry depends as much upon its ability to create a foreign market as it does upon the control of home consumption.

The very close competition which existed before the war had so reduced the American dye industry that it had ceased to be a factor in the market. The sudden curtailment of the German trade made it necessary for America to turn to other sources. England and Switzerland were the only possibilities. England soon put an embargo on the exportation of dyes, and the Swiss output was wholly inadequate. There was but one thing to do, namely, to develop the home industry, and this short article has indicated how satisfactorily this has been accomplished.

The Lowell Textile School has greatly aided in this enterprise by carrying out numerous experiments in its chemistry and dyeing department and by turning a large number of valuable workers into this field. Among its graduates are numbered some of the foremost dyestuff chemists and colorists in this country.

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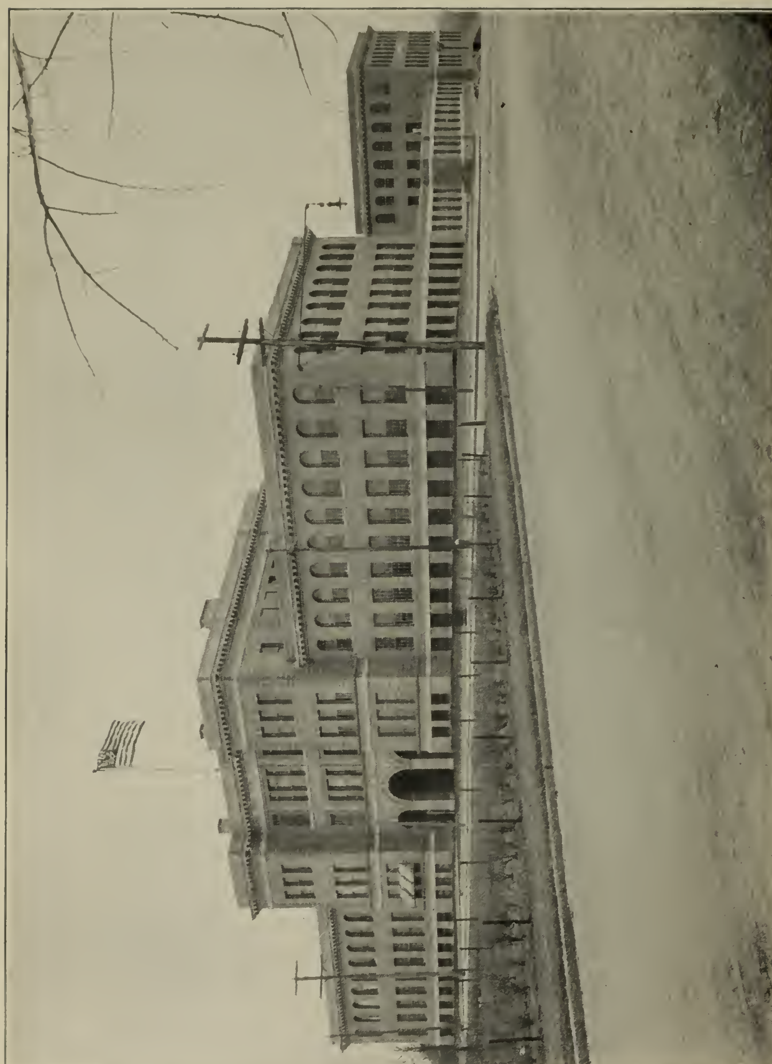
1917, authorized October 31, 1918

Moody Street and Colonial Avenue



TRUSTEES OF THE LOWELL TEXTILE SCHOOL.

Athletics.

Royal P. White. William R. Moorhouse. Edward M. Abbot.

Evening School.

Hugh J. Molloy. John J. Donovan. Joseph A. Gagnon.

OFFICERS OF INSTRUCTION AND ADMINISTRATION.

Charles Holmes Eames, S.B., Billerica.
President.

Louis Atwell Olney, S.B., M.S., 118 Riverside Street.
Professor of Chemistry; in charge of Department of Chemistry and Dyeing.

Edgar Harrison Barker, 9 Mount Hope Street.
Professor of Textiles; in charge of Department of Wool Yarns.

Arthur Andrew Stewart, 56 Robbins Street.
Professor of Textiles; in charge of Department of Finishing.

Stephen Eaton Smith, 409 Lowell Street, Methuen.
Professor of Textiles; in charge of Department of Cotton Yarns and Knitting.

Hermann Henry Bachmann, 37 Plymouth Street.
Professor of Textile Design; in charge of Department of Design and Weaving.

Lester Howard Cushing, A.B., 10 Walden Street.
Professor of History and Economics; in charge of Department of Languages, History and Economics; Secretary of the Faculty.

Herbert James Ball, S.B., B.C.S., 119 Wentworth Avenue.
Professor of Textile Engineering; in charge of Department of Textile Engineering and Accountancy.

Stewart Mackay, North Chelmsford.
Assistant Professor of Textile Design.

John Charles Lowe, 161 Dracut Street, Dracut.
Assistant Professor of Textiles.

Martin John Hoellrich, 30 Saxonia Avenue, Lawrence.
Assistant Professor of Weaving.

Elmer Edward Fickett, B.S., 162 Hovey Street.
Assistant Professor of Analytical Chemistry.

Frederick Steere Beattie, Ph.B., 17 Osgood Street.
Assistant Professor of Organic Chemistry.

Philip Osborne Yeaton, S.B., A.B., 112 Mount Washington Street.
Assistant Professor of Mechanical Engineering.

Harold Canning Chapin, Ph.D., 290 Pine Street.
Assistant Professor of General Chemistry.

Charles Lincoln Howarth, B.T.C., North Billerica.
Assistant Professor of Dyeing.

Percy Charles Judd, 272 Merrimack Street.
Assistant Professor of Mathematics and Electrical Engineering.

Charles Harrison Jack, R. F. D. No. 3, Nashua, N. H.
Instructor in Machine Shop Practice.

Cornelius Leonard Glen, 110 Mount Washington Street.
Instructor in Finishing.

Arthur Kimball Johnson, S.B., South Chelmsford.
Instructor in Chemistry.

Hartman Frank Schmidt, 68 Oakland Street.
Instructor in Wool Yarns.

Gilbert Roscoe Merrill, B.T.E., 2 Percy Street, Dracut.
Instructor in Cotton Yarns and Knitting.

Harry Chamberlain Brown, S.B., 272 Merrimack Street.
Instructor in Physics and Mathematics.

James Guthrie Dow, A.B., 149 B Street.
Instructor in Languages.

Albert Greaves Sugden, 13 D Street.
Instructor in Weaving.

Emma Elizabeth Whitney, 137 Riverside Street.
Instructor in Design and Decorative Art.
Arthur Joseph Woodbury, 24 Cornell Street.
Instructor in Cotton Yarns.
Ai Edwin Wells, B.T.E., Dracut.
Instructor in Electrical Engineering.
Philip Machon, North Chelmsford.
Instructor in Wool Sorting.
Russell Metcalf Fox, 359 Beacon Street.
Instructor in Textile Design.
Charles Arthur Everett, B.T.C., 14 Mount Washington Street.
Instructor in Dyeing.
Roland Taylor Pihl, S.B., 282 Pawtucket Street.
Instructor in Mathematics.
Lester Whiting Ball, S.B., 119 Mount Washington Street.
Instructor in Mechanical Drawing.
Edward Wheeler Scripture, Jr., 25 Seventh Avenue.
Instructor in Chemistry.
Stephane Frederick Toupin, 320 Hildreth Street.
Assistant Instructor in Mechanical Drawing.
Everette Vernon Steele, 141 Pawtucket Street.
Assistant Instructor in Chemistry.
George Paul Feindel, 141 Pawtucket Street.
Assistant Instructor in Chemistry.
Edward Francis Moore, 115 Mount Vernon Street.
Assistant Instructor in Wool Yarns.
George Joseph Lariviere, 125 Mount Washington Street.
Assistant Instructor in Cotton Yarns.
John Maurice McArthur, 32 New York Street.
Assistant Instructor in Machine Shop Practice.
Walter Ballard Holt, 18 Mount Vernon Street.
Bursar.
Ruth Foote, A.B., S.B., Kimball Street, Nashua, N. H.
Registrar.
Florence Moore Lancey, 46 Victoria Street.
Librarian.
Helen Gray Flack, S.B., 445 Stevens Street.
Secretary.
Gladys Pearl Braden, 77 Woodward Avenue.
Clerk.
Mona Blanche Palmer, 685 Westford Street.
Clerk.

THE LOWELL TEXTILE SCHOOL.

History. — The Lowell Textile School was established by the Trustees of the Lowell Textile School of Lowell, Massachusetts, incorporated in accordance with chapter 475, Acts of 1895. The movement for the establishment of the school dates from June 1, 1891, but it was not opened for instruction until February 1, 1897.

In accordance with the acts of incorporation the Board of Trustees consisted of twenty permanent and self-perpetuating members, three-fourths of whom must be "actively engaged in, or connected with, textile or kindred manufactures." In addition, His Honor the Lieutenant-Governor, the Commissioner of Education of the State, the mayor, the president of the municipal council, the superintendent of schools of Lowell, and a representative of the textile council were members *ex officio*. Legislative acts of 1905 and 1906 authorized the graduates of the school to elect four trustees serving for periods of four years each.

By virtue of the anti-aid amendment to the State Constitution, and by chapter

274, General Acts of 1918, the property of the school was transferred on July 1, 1918, to the Commonwealth of Massachusetts, and the control and management of the school was vested in a Board of Trustees appointed by the Governor, "with all the powers, rights and privileges and subject to all the duties" of the original Board.

In locating the school at Lowell, which has been called the "Mother Textile City of America," considerable advantage is secured by close association with every branch of the industry, which utilizes almost every commercial fiber in the products of the great Merrimack Valley textile district.

Although the school was formally opened by Governor Roger Wolcott on January 30, 1897, in rented quarters in the heart of the city, it was not until January, 1903, that the first buildings of the present plant were ready for occupancy. On February 12, 1903, Governor John L. Bates dedicated the present buildings.

Object. — The object of the establishment of the school as set forth in the original act was "for the purpose of instruction in the theory and practical art of textile and kindred branches of industry."

The plan was occasioned by the apparent crisis in the leading industry of New England, due to the rapid development of the manufacture of the coarser cotton fabrics in the southern States. It was believed that this crisis could be met only by a wider and more thorough application of the sciences and arts in the production of finer and more varied fabrics.

Following the general methods and systems found successful at the higher polytechnic institutes, it offers thorough instruction in principles of the sciences and arts applicable to textile and kindred branches of industry. The courses treat not only of the theory but also the application of these principles in the processes, on the machines and throughout all departments of industry involved in the successful manufacture, application and distribution of textile material in any form.

Because of the breadth, grade and character of instruction given, and because of the standing and personnel of the instructing staff, the school has been placed by both Federal and State educational boards in the class of the higher technological schools of this country.

Though from the first the management has kept in view the clearly defined objective which called for the establishment of the school, to meet the needs of the textile and kindred industries, it has developed its curriculum, its methods of instruction, and equipment as those needs arose. This objective will be kept constantly in view, and as new demands are presented an effort will be made to extend courses, equipment and floor space. The mechanical equipment of the school includes the best makes of textile machinery, and these machines, while built as they would be for regular work, are, as far as possible, adapted to the experimental work which is of particular value in such an institution as this. There is a more varied equipment in this school than in any other, either in America or Europe, and it is now possible to convert the raw stock into the finished fabric within the school.

The day classes have been organized for those who can devote their entire time for three or more years to the instruction requisite in preparing to enter the textile industries. It has been found necessary to require of all such students educational qualifications equivalent to those given by a regular four-year course of a high school or academy of good standing.

The evening classes are held for about twenty weeks of the year, and are for those who are unable to attend the day courses. These are similar to the day courses, but are aimed especially to meet the needs of students working during the day in the mills and shops. For entrance to these classes an applicant should have the equivalent of a grammar school education. A detailed description of these courses and requirements is given in another Bulletin, which will be sent upon request.

The trustees and faculty of the school confer the degrees of Bachelor of Textile Engineering (B.T.E.) and Bachelor of Textile Chemistry (B.T.C.) upon those students who satisfactorily complete one of the prescribed four-year courses. A diploma is awarded to those who satisfactorily complete one of the three-year courses.

The growth of the school has been constant, as is evident from the fact that when it was opened, February 1, 1897, there were 32 day and 110 evening pupils. The present school year of 1923–24 shows a registration of 238 pupils in the day classes and 733 in the evening classes.

DAY CLASSES.

CALENDAR.

1923.		1924.
September 13–14	Entrance examinations.	September 11–12
September 17–22	Re-examinations.	September 15–20
September 24	Registration.	September 29
September 25	Opening of day school.	September 30
October 12	Columbus Day, a holiday.	October 12
November 27	School classes at 4.30 P.M.	November 26
	THANKSGIVING RECESS.	
December 3	School opens at 8.45 A.M.	December 1
December 19	School closes at 4.30 P.M.	December 19
	CHRISTMAS VACATION.	
1924.		1925.
January 3	School opens at 8.45 A.M.	January 5
January 21	Semi-annual examinations begin.	January 26
February 2	End of first term.	February 6
February 4	Opening of second term.	February 9
February 22	Washington's Birthday, a holiday.	February 22
April 15	School closes at 4.30 P.M.	April 15
	SPRING RECESS.	
April 21	School opens at 8.45 A.M.	April 20
May 26	Final examinations.	May 25
May 30	Memorial Day, a holiday.	May 30
June 10	Graduation.	June 9
June 12–13	Entrance examinations.	June 11–12

ENTRANCE REQUIREMENTS.

Degree Courses.

Candidates for admission to either of the degree courses must be graduates of a school approved by the New England College Entrance Certificate Board, or by the Board of Regents of New York, or of a school of recognized equivalent grade, and must present a certificate from the principal of the school last attended, reporting upon the subjects pursued and the points obtained according to the schedule of studies given hereafter. A total of fourteen points is required.

A point represents satisfactory work in a year's study in a specified subject in an approved secondary school.

Required Subjects.	Points.
Algebra A1	1
Algebra A2	1
English	3
Elementary French A (two years) or Elementary German A (two years)	2
Plane Geometry	1
History (American, Mediæval and Modern, or English)	1
Physics	1
	10

Elective Subjects.

Chemistry	1
English	1
Elementary French (two years) or Elementary German (two years)	2
Advanced French or German (one year in addition to requirements of Elementary French A or Elementary German A)	1
History:	
American	1
Mediæval and Modern	1
English	1
Latin	1
Mechanical Drawing	1
Mechanic Arts	1
Solid Geometry	1
Spanish	1
Trigonometry	1

An applicant may also be admitted on the basis of entrance examinations in which case he must pass a sufficient number of the required subjects to make nine points, and present certificates showing satisfactory courses in such of the elective subjects to make five additional points.

The object of the elective requirements is to encourage greater breadth of preparation than that covered by the required branches. Certificates covering other subjects than those listed as elective will be entertained.

Diploma Courses.

Candidates for admission to the diploma courses are accepted upon presentation of properly vouched certificates showing the completion of a regular four-year course in a high school or academy of reputable standing. The certificate must specify that the applicant has satisfactorily passed the required subjects.

A total of ten points is required.

Required Subjects.	Points.
Algebra A1	1
Algebra A2	1
English	3
Plane Geometry	1
History (American, Mediæval and Modern, or English)	1
Physics	1
	8

Elective Subjects.

English (additional year)	1
Elementary French (one year)	1
Elementary German (one year)	1
History (American, Mediæval and Modern, or English)	1

ENTRANCE EXAMINATIONS.

All students who are unable to present a certificate for either the degree or the diploma courses must pass entrance examinations. Notification of intention to take these examinations must be made in writing at least a week before the date of the examinations. These will be held as follows: —

Thursday, June 12, 1924; Thursday, September 11, 1924; Thursday, June 11, 1925: —

Algebra, 9 A.M. to 11 A.M.
History, 11 A.M. to 1 P.M.
English, 2 P.M. to 4 P.M.

Friday, June 13, 1924; Friday, September 12, 1924; Friday, June 12, 1925: —
Plane Geometry, 9 A.M. to 11 A.M.
German or French, 11 A.M. to 1 P.M.
Physics, 2 P.M. to 4 P.M.

Candidates failing to pass the June examinations are allowed to try again in September; those who cannot attend the June examinations may present themselves in September.

REQUIRED SUBJECTS FOR ENTRANCE.

Algebra.

ALGEBRA A1. — Fundamental operations, factoring, determination of the highest common factor and least common multiple, fractions, simple and complex, simple equations of one or more unknown quantities, problems involving linear equations of either numerical or literal quantities, radicals, involution and evolution, square and cube root, ratio and proportion, exponents including fractional and negative.

ALGEBRA A2. — Quadratic equations both numerical and literal. Simple problems involving one or more unknown quantities that may be solved by the methods of linear or quadratic equations, binomial theorem for positive integral exponents, problems involving methods of arithmetical and geometrical progressions.

Plane Geometry.

The usual theorems and constructions of good textbooks, including the general properties of plane rectilinear figures, the circle and the measurement of angles, similar polygons, areas, regular polygons, and the measurement of the circle. The solution of original problems and problems in mensuration of lines and plane surfaces.

English.

As secondary schools are following to a greater extent than heretofore the requirements of the College Entrance Examination Board, it is recommended that the applicant to this school conform to the suggestions of this Board relative to English composition and literature.

The examination consists of two parts, both of which are given at the same time.

(*a*) With the object of testing the student's ability to express his thoughts in writing clearly and correctly he will be required to write upon subjects familiar to him. Emphasis will be laid upon the composition, punctuation, grammar, idiom, and formation of paragraphs. He will be judged by how well he writes rather than by how much he writes.

(*b*) The second part of the examination is prepared with the view of ascertaining the extent of the student's knowledge of good literature, and to test this examination questions will be based on the books adopted by the National Conference on Uniform Entrance Requirements. Any course of equivalent amount if made up of standard works will be accepted.

Modern Languages.

REQUIREMENTS FOR DEGREE COURSES.

It is expected that the work in these subjects has covered a period of at least two years of preparatory school training or the equivalent. Importance should be given to the ability to translate into good idiomatic English, but attention should also be paid to grammar and construction, that greater care may be used in translation.

ELEMENTARY GERMAN A. — The entrance examination is composed of two parts, both taken, however, at the same time.

(*a*) Translation of simple German prose into good idiomatic English.

(*b*) Questions to test proficiency in grammar, and simple English sentences to be rendered into German.

The requirements include the declension of articles, adjectives, pronouns and nouns; the conjugation and inflection of weak and strong verbs; the simpler uses

of the subjunctive; the use of the modal auxiliaries; the prepositions and their uses; the principal parts of important verbs; and the elementary rules of syntax and word order.

Texts used in the language courses of any reputable high or preparatory school will furnish reading for translation. A list of texts is offered by the College Entrance Examination Board.

Elementary French A. — The entrance examination is composed of two parts, both taken, however, at the same time.

(*a*) Translation of simple French prose into good idiomatic English.

(*b*) Questions to test proficiency in grammar, and simple English sentences to be rendered into French.

The requirements include the principal parts, conjugation and inflection of the regular and the more common irregular verbs; the singular and plural forms of nouns and adjectives; the uses of articles and partitive construction; the forms and positions of personal pronouns; and the simpler uses of the conditional and subjunctive.

Suitable texts are suggested by the language courses of any reputable high or preparatory school and by the requirements of the College Entrance Examination Board.

Note. — Students who have pursued two years of elementary French as well as two years of elementary German may present one subject to cover two points in the required subjects, and the other to cover two points in the elective subjects.

History.

Applicants may offer a preparation of American history, English history or mediæval and modern history.

In American history applicants should be familiar with the early settlements in America, the colonies, their government, the customs of the people, and events which led to the establishment of the United States. They should be informed concerning the causes and effects of the principal wars in which the country has been involved. They should be prepared to consider also questions requiring an elementary knowledge of civil government, as well as historical facts connected with the growth of this country up to the present time.

For the subject of English history or mediæval and modern history the course given in any reputable secondary school should give proper preparation. A course extending over a full year with not less than three periods a week will be accepted.

Physics.

The applicant should be familiar with the fundamental principles of physics, particularly those considered under the headings of mechanics, heat, light, electricity and magnetism. Textbook instructions should be supplemented by lecture table experiments. Wherever possible, the student should pursue a laboratory course, but for the present no applicant will be conditioned in this subject if he has not been able to carry on a laboratory course. Where a laboratory course is offered by a secondary school, it should cover at least twenty-five of those experiments listed in the syllabus of the College Entrance Examination Board. An applicant should present his notebook, together with the certificate from the teacher under whom the work was performed.

ELECTIVE SUBJECTS.

History.

If the applicant can present all three or any two branches of history specified he may include one as a required subject and the others in the list of elective subjects.

Chemistry.

Applicants must show evidence of their familiarity with the rudiments of chemistry. Any course given in a secondary school organized to present instruction by means of textbook or lecture, together with correlated laboratory work, will be considered as covering the requirements. The applicant's notebook with his

original notes, including description of experiments, apparatus used, reactions, observations and deductions, must be accompanied by his instructor's certificate.

Importance will be placed upon manipulation and deductions as well as the general appearance and neatness of the notebook.

Solid Geometry.

The usual theorems and constructions of good textbooks, including the relations of planes and lines in space, the properties and measurement of prisms, pyramids, cylinders and cones; the sphere and spherical triangles. The solution of original problems and the applications of the mensuration of surfaces and solids.

Trigonometry.

The usual courses of instruction covered by the standard textbooks on plane and spherical trigonometry will prepare an applicant sufficiently to meet this requirement.

Mechanical Drawing.

The applicant must have pursued such a course in mechanical drawing that he will be familiar with the usual geometrical construction problems, projection of points, lines, planes and simple solids.

Importance is laid not only upon the accuracy with which the work is performed, but upon the general arrangement, appearance and care with which the plates are executed.

It should not be understood that work in this subject may be offered as the equivalent of the first term's work at the school.

Mechanic Arts.

The usual courses offered by properly equipped preparatory schools will be accepted as suitable fulfillment of this requirement. Work should include instruction in the handling of both wood and metal working tools in the more simple practices of these arts.

Modern Languages for Diploma Courses.

Elementary French B. — Applicants who enter for one of the three-year courses may present one year's work in French in a secondary school. Those who present themselves for examination in this subject should be familiar with the rudiments of grammar, and be able to translate simple French prose into good idiomatic English, also to translate into French English sentences based on the French given for translation.

Elementary German B. — Applicants who enter for one of the three-year courses may present one year's work in German in a secondary school. What is stated in regard to French applies to those who may present German instead of French.

Advanced French or German.

In cases where applicants have pursued courses in French or German for more than two years, and have completed work which is more advanced than is included under elementary French or German, they may offer the additional year as an elective.

English.

In many secondary schools this subject is required during all of the four years, and where it is pursued to this extent the applicant may offer the additional year's work as one of his elective subjects.

Spanish.

Students offering Spanish should be familiar with elementary grammar, the common irregular verbs, and be able to translate simple Spanish to English or English to Spanish. A preparation equivalent to three periods per week for two years will be acceptable.

Latin.

Students who have pursued one or more years of Latin may present this subject as an elective. Each year's work satisfactorily completed will be considered equal to one point.

GENERAL INFORMATION.

Preparation. — Particular stress should be laid upon a thorough grounding in mathematics, including algebra, arithmetic and plane geometry, as these form the basis upon which the work of this school rests. While solid geometry is not required at the present time, the student will find a knowledge of this subject very valuable in his subsequent work, and is strongly recommended to include this subject as one of his electives. A preliminary course in science, including physics and chemistry, serves to prepare the student's mind for the higher branches of these subjects and their application, but neither will be considered as the equivalent of the courses in these branches given in the school.

Advanced Standing. — Candidates who may have received previous training in any of the subjects scheduled in the regular course will, upon presentation of acceptable certificates, be given credit for such work.

Registration. — All students are required to register on or before the Monday of the week beginning the school year, and again during the first week of the mid-year examination period. For unexcused delay in registration a fee of $5 will be imposed.

Application Blanks. — A blank form of application for admission may be found at the end of this bulletin. This should be properly filled out by all applicants, whether entering upon certificate from a secondary school or presenting themselves for examination.

Fees. — The fee for the day course is $150 per year for residents of Massachusetts. For non-residents the fee for all courses is $200 per year. The fee for students from foreign countries is $300 per year.

Three-fifths of the fee is charged for a single term. Each term's tuition is payable during the first week of that term. Students failing to make this payment at the specified time will be excused from classes until satisfactory explanation and arrangements for payment can be made. *No bills will be sent.* After payment is made no fee or part thereof can be returned, except by special action of the trustees.

An athletic fee of $15 is due and payable at the time of the first payment of tuition.

Special students pay, in general, the full fee, but if a course be taken involving attendance at the school during a limited time, application may be made to the president for a reduction.

Students must provide their own books, stationery, tools, etc., and pay for any breakage or damage that they cause. The above fee includes free admission for any day students desiring to attend any of the evening classes in which there is accommodation.

For all first-year students a minimum deposit of $25 is required to cover the cost of breakage, supplies, and apparatus and chemicals used in the Chemical Laboratory, the unexpended balance to be returned to the student at the end of the year.

For all students in second, third and fourth years taking work in Chemistry and Dyeing Laboratories a deposit of $25 for the first term and $25 for the second term is required. Students taking Machine Shop will be required to make a deposit of $15 to cover cost of materials, supplies and breakage. Included in this charge is a kit of tools which is essential to the work, and which becomes the personal property of the student. The unexpended balance will be returned at the end of the year.

Fees are strictly payable in advance, and students whose fees remain unpaid after the above-mentioned dates will not be admitted to classes.

All deposits must be made before students can be admitted for laboratory work.

Examinations. — For first-year students intermediate examinations are held every five weeks, and these serve to inform the student concerning his standing and the progress made.

For students in upper classes informal examinations will be held during the eighth week of each term.

Formal examinations are held at the end of each term.

In general, the examinations cover the work of the preceding term, but at the discretion of the instructor may include work of earlier terms.

Examinations for students conditioned in first-term subjects are held in June, and examinations for students conditioned in the second-term examinations are held in September following. Students requesting condition examinations at other than scheduled dates will be required to pay $5 for each examination so taken.

Any student who fails to complete a subject satisfactorily, or to clear a condition at the time appointed, will be required to repeat or drop the subject, and he cannot be admitted to subjects dependent thereon.

A student whose term's standing is as a whole so low that he cannot continue with profit the work of the next term will be required to leave school, but he may return the following year to repeat such subjects as are required.

Daily work and regularity of attendance are considered in making up the reports of standing.

Continued or persistent absence or tardiness from the classes is considered reason to exclude a student from the class.

Records and Reports of Standing. — During each term informal reports are sent to parents or guardians of all students under age, and to all students; and at the end of each term formal reports are made.

The daily work of the student forms an important part of his record, and no pupil will be awarded the diploma or degree unless this portion of his record is clear.

Books are prescribed for study, for entry of lecture notes and other exercises, and are periodically examined by the lecturers. The care and accuracy with which these books are kept are considered in determining standing.

Attendance. — Attendance is required of all students on fourteen-fifteenths of all scheduled class exercises, provided they meet the requirements of their instructors for the omitted exercises. For every unexcused absence from any class exercise in excess of those allowed, a deduction from the mark obtained in the course in which the absences occurred will be made.

Advisors. — Advisors are appointed for all students, to be of what aid and assistance they can both inside and outside of school hours. The head of the department in which a student is registered is advisor to upper classmen, and men in charge of freshmen classes act as advisors to freshmen.

Thesis. — Each candidate for the degree of the school must file with the head of the department in which the thesis is taken, and not later than May 15, a report of original investigation or research, written on a good quality of paper, 8 by 10 inches, with 1-inch margin at left, and one-half inch at right, of each page; such thesis to have been previously approved by the head of the department in which it is made.

For all candidates for the diploma this requirement will be optional on the part of the school.

Graduate Course. — Graduates of technical courses of other schools are invited to communicate with the president with reference to special courses in the textile studies. Previous training in the sciences and the engineering branches will usually reduce materially the time necessary to complete any of the courses at this school. The advantages offered to such persons for special research work are unexcelled, and a most profitable course may be arranged.

Degrees. — The degree of Bachelor of Textile Engineering will be awarded for the completion of the four-year course in textile engineering. The degree of Bachelor of Textile Chemistry will be awarded for the completion of the four-year course in chemistry and textile coloring.

Diploma. — For the present the diploma of the school will be awarded upon the satisfactory completion of any one of the regular three-year courses. In cases where students obtain advanced standing, at least one year's attendance is required before the diploma can be obtained.

Conduct. — Students are required to return to the proper place all instruments or apparatus used in experimental work, and to leave clean and in working order all machinery and apparatus with which they may experiment. All breakages, accidents or irregularities of any kind must be reported immediately to the head of the department or instructor in charge.

In case of either day or evening students, irregular attendance, lack of punctuality, neglect of either school or home work, disorderly or ungentlemanly conduct or general insubordination are considered good and sufficient reasons for the immediate suspension of a student, and a report to the trustees for such action as they deem necessary to take.

It is the aim of the trustees so to administer the discipline of the school as to maintain a high standard of integrity and a scrupulous regard for trust. The attempt of any student to present, as his own, work which he has not performed, or to pass any examination by improper means, is regarded by the trustees as a most serious offence, and renders the offender liable to immediate suspension or expulsion. The aiding or abetting of a student in any dishonesty is also held to be a grave breach of discipline.

Any student who violates these provisions will be immediately suspended by the president, and the case reported at the following meeting of the trustees for action.

Library and Reading Room. — That the students may have surroundings conducive to reading and study a moderate-sized reading room with library tables and chairs has been provided. The library shelves contain textile, art, engineering and scientific publications. These are increased from time to time as new technical books of value to textile students are issued from the press. The leading textile papers are kept on file for ready reference.

Sessions. — The regular school sessions are in general from 8.45 A.M. to 12.45 P.M., and from 1.45 to 4.30 P.M., except Saturdays, when there is no session of the school. On Saturday afternoons the buildings are closed.

An hour plan designates the hours at which the various classes meet. This is rigidly adhered to, and the student is marked for his attendance and work as therein scheduled.

Residence and Expenses. — Students from a distance, requiring rooms and board in the city, may, if they desire, select the same from a list which is kept at the school. The cost of rooms and board in a good district is from $11 per week upwards.

All raw stock and yarn provided by the school, and all the productions of the school, remain, or become, the property of the school, except by special arrangement; but each student is allowed to retain specimens of yarn or fabrics that he has produced, if mounted and tabulated in accordance with the requirements of the school. It is understood that the school may retain such specimens of students' work as they may determine.

Lockers are provided for the use of the students, sufficiently capacious to contain clothing, books and tools.

No books, instruments or other property of the school are loaned to the students to be removed from the premises except by special permission.

Scholarships. — The Massachusetts Charitable Mechanics Association have offered two scholarships of $250 each which are for the purpose of defraying school expenses of such students who may be selected by a committee composed of a representative from the Association, one from the Board of Trustees and the President of the School.

Herbert A. Currier of the class of 1906 has offered a prize of $150 to a student who may be selected by the faculty of the school and in making the selection the following conditions will be considered: scholastic standing, financial need and ability in promoting student activities in school life. Scholarship to be available to some member of the sophomore, junior or senior classes.

Medals of Honor. — The National Cotton Manufacturers' Association offers annually a medal to that member of the graduating class who shall have during his course attained the highest standing in the special subjects required by the vote of the association.

Special Awards of Merit. Louis A. Olney Book Prize. — For several years a friend of the school has offered prizes in the form of books to be awarded to the successful candidates on graduation day. The prizes are continued each year. The conditions in detail are as follows: —

First. — Ten dollars to the student taking the regular Chemistry and Textile Coloring Course who shall be considered as having attained the highest scholarship in first-year chemistry.

Second. — Five dollars to the student taking the regular Chemistry and Textile Coloring Course who shall be considered as having attained the second highest scholarship in first-year chemistry.

Third. — Ten dollars to the regular student of the Chemistry and Textile Coloring Course who shall be considered as having attained the highest scholarship during his second year.

Fourth. — Five dollars to the regular student of the Chemistry and Textile Coloring Course who shall be considered as having attained the second highest scholarship during his second year.

Fifth. — Twenty dollars to the regular student in the Chemistry and Textile Coloring Course who shall present the best thesis preparatory to graduation.

The above-mentioned sums are to be invested in books which may be selected after graduation. In case no one is considered worthy of any particular scholarship prize, or if there is no competition, the same may be withheld. The decision in such case shall rest with the judges.

Edward A. Bigelow Prize. — Edward A. Bigelow, class of 1906, has offered the following cash prizes: $75 to the member of the graduating class from the Wool Manufacturing course who maintains the highest standing throughout his three years. $50 to the member of the second year class in the Wool Manufacturing course who maintains the highest standing during his second year. $25 to the member of the first year class in the Wool Manufacturing course who maintains the highest standing during his first year.

Saco-Lowell Prize. — The Saco-Lowell Machine Shop of Lowell, Mass., offers a prize of $100 for the thesis prepared for graduation which will be considered of greatest value to the textile industry. Only candidates for a degree are eligible for this prize and the selection is to be made by a board comprised of three members, one from the Saco-Lowell Shops, one from the National Association of Cotton Manufacturers and one from the Lowell Textile School.

Textile Colorist Award. — The Textile Colorist, Inc., has offered a prize of $100 to be awarded to a member of the graduating class whose thesis, based upon his personal researches and experiences, is of the greatest practical value to the dyeing, bleaching or textile finishing industries.

Awards. — Gold medal, Paris Exposition, 1900, for general excellence. A special medal, Merchants and Manufacturers Exposition, Boston, 1900. The Pan-American medal, awarded to the school, 1901. Gold medal, Louisiana Purchase Exposition, 1904. Gold medal, Lewis and Clark Centennial Exposition, 1905. Medal of honor from Panama-Pacific International Exposition, 1915.

Bulletins and Catalogues. — All students registering and paying the regular fee for the course selected are entitled to the bulletins and catalogues when issued.

COURSES OF INSTRUCTION.

Since its establishment the Lowell Textile School has offered courses, each of which extends over a three-year period. With the development of the school and close study of the problems arising in the later experience of the graduates it is believed that attention should be given those branches of instruction which would give breadth of training as well as establish fundamental principles. This policy has resulted in extending the curriculum to such length that the need for an additional year's instruction was evident.

The fact was also appreciated that to carry on the more advanced work a better preparation must be demanded of the applicant for entrance.

Nevertheless, it was recognized that many young men seeking employment in the textile industry do not care, or are not in a position, to devote four years to scholastic preparation, and for these the regular three-year courses are offered.

These courses are designated as Cotton Manufacturing, Wool Manufacturing and Textile Design (General Textile Courses).

At the completion of any one of these the regular diploma of the school is awarded.

In general, it is assumed that students pursuing these courses will not take the advanced work of the fourth year. However, if a student electing one of the three-year courses desires to change to one of the four-year courses he may do so providing his preparation and undergraduate standing permit it.

The four-year courses are Textile Engineering, Chemistry and Textile Coloring. At the completion of these courses the degrees of Bachelor of Textile Engineering (B.T.E.) and Bachelor of Textile Chemistry (B.T.C.) are conferred.

Three options are offered in the Engineering Course, viz., general textile, cotton manufacturing or wool manufacturing. Each of these courses is planned to train one in the fundamental principles of science found to be applicable in the particular fields of textile chemistry and textile engineering. It is maintained that for one to be successful in either of these important branches of industry a training is required as thorough and broad as that of any of the recognized branches of engineering or of applied science.

With this in mind these courses have been built of a secure framework of science and mathematics, and to it has been added the useful application of these branches in the broad textile field. With the direct purpose of laying a secure foundation in the training, a more extended preparatory course is first demanded, and subsequently in the school work more subjects of a general character are included, that narrowness of judgment and observation may not result by overstimulation of the technical development.

Courses for Women. — Although all classes are open to women, the courses which have appealed especially to their tastes have been textile designing and decorative art. Some have pursued courses in chemistry, and have added to their work in design some instruction in power weaving and finishing. These special courses have in general been followed for three years, and in some cases have led the students to positions either in the mill office or in some commercial lines that have been desirable and have offered congenial work.

Within the last few years the possibilities for women in certain branches of textile chemistry have become recognized, and it is believed that in the future the positions open to them will become more and more numerous.

Government Positions. — One of the significant and important facts that has been clearly demonstrated during the recent conflict is the great value of a technical education. In no war has the applied science been so forcefully used as a weapon of combat.

An earlier catalogue pointed out the calls that the various departments of the government were making for graduates from this school in common with those of other technological institutions. The success attained by past students has been presented in a previous bulletin. As these men have shown their value to the government in times of war, so will they in times of peace. Before the war various departments of the government had found need for graduates from this textile school, and with the problems of peace the need undoubtedly will become greater.

The United States Civil Service Commission recognizes graduates from the degree courses of this school as proper applicants for the examination to the various positions requiring a knowledge of applied science and engineering, as well as a knowledge of textile manufacturing, in the different departments of the government.

COURSES.

In the column headed "Hours of Exercise" the numbers represent for each particular subject the total hours required in school for a period of fifteen weeks.

The letter and number which follow the subjects indicate the department in which the subject is given and the number of the subject in that department. For detailed description of the same, see page 23.

The departments are indicated as follows: —

Textile Engineering, B.
Chemistry and Dyeing, C.
Textile Design and Power Weaving, D.
Languages and History, E.
Cotton Yarns, F.
Woolen and Worsted Yarns, G.
Finishing, H.

By referring to the letter and number indicated under "Preparation" the student can ascertain what subjects are necessary in order that he may have a clear understanding of the subject which he is scheduled to take.

First Year. First Term. (Hours of Exercise.)

[Common to all courses.]

Mechanics B–3 (60 hrs.).
Mechanical Drawing B–7 (83 hrs.).
Mathematics B–1 (45 hrs.).
Textile Design D–1 (90 hrs.).
Elementary Chemistry C–1 (157 hrs.).
English E–1 (45 hrs.).
Modern Language E–2 or E–4 (30 hrs.).
Physical Education (30 hrs.).

First Year. Second Term. (Hours of Exercise.)

Mechanism B–4 (Course VI — 60 hrs.) (Course IV — 60 hrs.).
Mechanical Drawing B–8 and B–9 (Course VI — 83 hrs.) (Course IV — 30 hrs.)
Mechanical Laboratory B–6 (Course VI — 28 hrs.).
Mathematics B–1 (Course VI — 45 hrs.) (Course IV — 45 hrs.).
Textile Design D–1 (Course VI — 69 hrs.).
Elementary Chemistry C–1 (Course VI — 75 hrs.) (Course IV — 75 hrs.).
Technology of Fibers F–1 and G–1 (Course VI — 60 hrs.) (Course IV — 60 hrs.).
English E–1 (Course VI — 30 hrs.) (Course IV — 30 hrs.).
Elementary German E–2 or Elementary French E–4 (Course VI — 30 hrs.) (Course IV — 30 hrs.).
Qualitative Analysis C–2 (Course IV — 135 hrs.).
Stoichiometry C–3 (Course IV — 15 hrs.).
Physical Education (Course VI — 30 hrs.) (Course IV — 30 hrs.).
For second-term subjects in Courses I, II, and III, see pages 16, 17, 18.

Course I. — Cotton Manufacturing.

The Cotton Manufacturing Course is designed for students contemplating a career in the manufacturing of cotton yarns and cloth or allied industries, and wishing to devote but three years to the school work.

During the first term the studies are common to all courses, and include instruction in mechanism, mathematics, mechanical drawing, textile design and elementary chemistry. Laboratory work supplements the lectures in chemistry, and hand-loom weaving assists in illustrating the principles of textile design. At the commencement of the second term instruction in the preliminary processes of yarn manufacturing is given in the course of technology of fibers.

The work in the Cotton Yarn Department comprises instruction in all the manufacturing processes from the bale to the finished yarn. The instruction is given by means of lectures upon the machines and processes, and by laboratory work upon the machines themselves. The third year's work in this department is largely devoted to lectures upon the manufacture of specialties, waste products, etc., and special laboratory work, special tests upon yarns and fabrics, mill planning with regard to the arrangement of machinery, and other work of an advanced nature.

The work in mechanism serves as a basis for all future machine and mechanical work, and is followed by steam engineering, electricity and mill engineering. The mechanical drawing taken in connection with these subjects augments this instruction as well as provides opportunity for students to become skilled in drafting.

The course in textile designing, cloth analysis and cloth construction includes lectures on plain and fancy weaves and Jacquard work, the analysis of all commercial fabrics, and designs for the same.

Commencing with lectures and practice upon plain looms, the student is taken through dobby and box-loom weaving and Jacquards.

A course in knitting taken during the third year includes the manufacture of hosiery and underwear. The course on the finishing of cotton fabrics is given by lectures and laboratory work, and requires considerable work on standard machines in the laboratory.

For detailed description of the subjects see page 23.

Course I. — Cotton Manufacturing.

[For first term see page 15.]

First Year. Second Term. (Hours of Exercise.)

Mechanism B–4 (60 hrs.).	Technology of Fibers F–1 (60 hrs.).
Mechanical Drawing B–8 (70 hrs.).	Elementary Chemistry C–1 (75 hrs.).
Mathematics B–1 (45 hrs.).	English E–1 (45 hrs.).
Textile Design D–1 (125 hrs.).	Physical Education (30 hrs.).

Second Year. First Term.

Cotton Yarn Mfg. F–2 (180 hrs.).	Machine Drawing B–10 (30 hrs.).
Textile Design D–2 (105 hrs.).	Steam Engineering B–12 (45 hrs.).
Power Weaving D–9 (60 hrs.).	Physics B–11 (45 hrs.).
Chemistry and Dyeing Lect. C–9 (30 hrs.).	Industrial History E–6 (15 hrs.).

Second Year. Second Term.

Cotton Yarn Mfg. F–2 (188 hrs.).	Steam Engineering B–14 (15 hrs.).
Textile Design D–2 (60 hrs.).	Machine Drawing B–10 (42 hrs.).
Power Weaving D–9 (130 hrs.).	Physics B–11 (45 hrs.).
Chemistry and Dyeing Lect. C–9 (15 hrs.).	Industrial History E–6 (15 hrs.).

Third Year. First Term.

Cotton Yarn Mfg. F–2 (165 hrs.).	Power Weaving D–10 (120 hrs.).
Knitting F–3 (60 hrs.).	Cotton Finishing H–2 (75 hrs.).
Design, Cloth Construction, D–6, 7 (30 hrs.).	Electricity B–20a (30 hrs.).
	Mill Engineering B–22 (30 hrs.).

Third Year. Second Term.

Cotton Yarn Mfg. F–2 (200 hrs.).	Power Weaving D–10 (132 hrs.).
Knitting F–3 (15 hrs.).	Cotton Finishing H–2 (73 hrs.).
Design, Cloth Construction, D–6, 7 (60 hrs.).	Textile Testing G–3 (30 hrs.).
	Thesis.

Course II. — Wool Manufacturing.

The course on wool manufacturing is arranged for those who contemplate a career in the manufacture of woolen or worsted fabrics, and can devote but three years to the school work. It includes instruction on all of the varied processes employed in manipulating the wool fiber to produce yarn and cloth, namely, sorting, scouring, carding, combing, spinning, designing, weaving, dyeing and finishing. The work is carried on by lectures, recitations and practical work in the laboratories.

Following the first term of the first year, which is common to all courses, the student in the course in technology of fibers is acquainted not only with the various kinds of wool and trade terms applied to them, but also with other commercial fibers, viz., cotton, silk, jute, hemp, flax, etc., used in the textile industry.

Beginning with the second year the details of manipulating wool from the grease to the finished yarn is taken up for close study. This includes the spinning of woolen yarn, also worsted yarn, by both the English and the French systems. The intermediate processes of sorting, scouring, carding, combing and top-manufacturing are taken in detail and in proper sequence.

Textile design, cloth analysis and construction are continued from the first year throughout the course, the work being applied especially to woolen and worsted goods. Weaving on power looms commences in the second year and continues through the third.

Lectures on finishing commence with the third year and are augmented by extensive practice with the machines in the Finishing Department.

Work in the Engineering Department extends throughout all three years, and includes mechanical drawing, steam engineering and electricity. The practical application of the principles studied in these subjects is brought out forcibly in the work on mill engineering, where mill design and construction are considered.

Course II. — Wool Manufacturing.

[For first term see page 15.]

First Year. Second Term. (Hours of Exercise.)

Mechanism B–4 (60 hrs.).	Technology of Fibers G–1 (60 hrs.).
Mechanical Drawing B–8 (70 hrs.).	Elementary Chemistry C–1 (75 hrs.).
Mathematics B–1 (45 hrs.).	English E–1 (45 hrs.).
Textile Design D–1 (125 hrs.).	Physical Education (30 hrs.).

Second Year. First Term.

Yarn Manufacture G–2 (210 hrs.).	Machine Drawing B–10 (30 hrs.).
Textile Design D–3 (75 hrs.).	Steam Engineering B–12 (45 hrs.).
Power Weaving D–9 (60 hrs.).	Physics B–11 (45 hrs.).
Chemistry and Dyeing Lect. C–9 (30 hrs.).	Industrial History E–6 (15 hrs.).

Second Year. Second Term.

Yarn Manufacture G–2 (230 hrs.).	Steam Engineering B–14 (15 hrs.).
Textile Design D–3 (60 hrs.).	Machine Drawing B–10 (42 hrs.).
Power Weaving D–9 (88 hrs.).	Physics B–11 (45 hrs.).
Chemistry and Dyeing Lect. C–9 (15 hrs.).	Industrial History E–6 (15 hrs.).

Third Year. First Term.

Yarn Manufacture G–2 (150 hrs.).	Power Weaving D–10 (120 hrs.).
Knitting F–3 (60 hrs.).	Finishing H–1 (75 hrs.).
Design, Cloth Construction D–6, 7 (45 hrs.).	Electricity B–20a (30 hrs.).
	Mill Engineering B–22 (30 hrs.).

Third Year. Second Term.

Yarn Manufacture G–2 (170 hrs.).	Power Weaving D–10 (138 hrs.).
Knitting F–3 (87 hrs.).	Finishing H–1 (75 hrs.).
Design, Cloth Construction D–6, 7 (60 hrs.).	Textile Testing G–3 (30 hrs.).
	Thesis.

Course III. — Textile Design.

The general course in textile design is planned to meet the demand of young men for a technical training in the general processes of textile manufacturing, but with particular reference to the design and construction of fabrics. To this end a foundation is laid in the first year by instruction in the elementary principles of designing, decorative art and weaving. That he may later in the course pursue to advantage instruction in yarn manufacturing, weaving, dyeing, finishing and some engineering problems, a foundation course in mechanics, mathematics and chemistry is laid. As the student is required to pursue courses in the yarn departments, he acquires a knowledge of the manufacture of cotton yarns from the bale to the yarn, and of woolen and worsted yarns from the fleece through the varied processes of manufacturing woolen yarn or worsted yarn.

Throughout his entire course he receives instruction in design, cloth analysis and construction of all the standard cloths. This is followed by advanced work in Jacquard designing and weaving, which serves not only to acquaint the student with the many kinds of figured design, but stimulates and develops any artistic talent he may possess. Decorative art becomes an important part of the work of the second and third years.

Power weaving commences with the second year and continues throughout the course, and work on all types of looms is required.

During the third year the student receives instruction in the finishing of cotton goods and woolen and worsted cloths. This instruction is given by means of lecture and laboratory work.

The engineering subjects given in the second and third years are intended to acquaint the student with such general knowledge as will be of assistance should he be called upon in later life to be a mill manager.

For detailed description of the subjects see page 23.

Course III. — Textile Design.

[For first term see page 15.]

FIRST YEAR. SECOND TERM. (HOURS OF EXERCISE.)

Mechanism B–4 (60 hrs.).	Tech. of Fibers F–1 and G–1 (60 hrs.).
Mechanical Drawing B–8 (70 hrs.).	Elementary Chemistry C–1 (75 hrs.).
Mathematics B–1 (45 hrs.).	English E–1 (45 hrs.).
Textile Design D–1 (125 hrs.).	Physical Education (30 hrs.).

SECOND YEAR. FIRST TERM.

Design, Decorative Art D–2, 3, 4 (150 hrs.).	Machine Drawing B–10 (30 hrs.).
Cotton Yarn Mfg. F–2 (105 hrs.).	Steam Engineering B–12 (45 hrs.).
Power Weaving D–9 (90 hrs.).	Physics B–11 (45 hrs.).
Chemistry and Dyeing Lect. C–9 (30 hrs.).	Industrial History E–6 (15 hrs.).

SECOND YEAR. SECOND TERM.

Design, Decorative Art D–2, 3, 4 (132 hrs.).	Wool Yarns G–2 (114 hrs.).
Cotton Yarn Mfg. F–2 (87 hrs.).	Steam Engineering B–14 (15 hrs.).
Power Weaving D–9 (45 hrs.).	Physics B–11 (45 hrs.).
Chemistry and Dyeing Lect. C–9 (15 hrs.).	Industrial History E–6 (15 hrs.).
	Machine Drawing B–10 (42 hrs.).

THIRD YEAR. FIRST TERM.

Design, Cloth Construction, Decorative Art D–6, 7, 8 (90 hrs.).	Power Weaving D–10 (75 hrs.).
Wool Yarns G–2 (120 hrs.).	Wool Finishing H–1 (75 hrs.).
Mill Engineering B–22 (30 hrs.).	Cotton Finishing H–2 (75 hrs.).
Knitting F–3 (15 hrs.).	Electricity B–20a (30 hrs.).

THIRD YEAR. SECOND TERM.

Design, Cloth Construction D–6, 7, 8 (129 hrs.).	Wool Finishing H–1 (75 hrs.).
Wool Yarns G–2 (72 hrs.).	Cotton Finishing H–2 (72 hrs.).
Knitting F–3 (15 hrs.).	Textile Testing G–3 (30 hrs.).
Power Weaving D–10 (117 hrs.).	Thesis.

Course IV. — Chemistry and Textile Coloring.

The four-year course in Chemistry and Textile Coloring, leading to the degree of B.T.C., is especially intended for those who wish to engage in any branch of textile chemistry, textile coloring, bleaching, finishing or the manufacture and sale of the dyestuffs or chemicals used in the textile industry. The theory and practice of all branches of dyeing, printing, bleaching, scouring and finishing are taught by lecture work supplemented by a large amount of experimental laboratory work and actual practice in the dyehouse and finishing room.

The underlying theories and principles of chemistry are the same, no matter to what industry the application is eventually made. Furthermore, no industry involves more advanced and varied applications of the science of chemistry than those of the manufacture and application of the coal-tar coloring matters. In addition, the textile colorist must consider the complex composition of the textile fibers, and the obscure reactions which take place between them and the other materials of the textile industry.

During the first year general chemistry, including both inorganic and organic, is taught by lectures and laboratory work, and this is supplemented during the second term by qualitative analysis and stoichiometry.

Advanced inorganic chemistry, as well as advanced organic chemistry, is studied during the second and third year as a continuation of the elementary chemistry of the first year, and much time is spent upon quantitative analysis, industrial chemistry, and textile chemistry and dyeing.

The foundation work in general chemistry is continued during the third year with courses in physical chemistry, organic laboratory work and analytical work. The subject of industrial chemistry is introduced, and much time is devoted to advanced textile chemistry, dye testing, color matching, calico printing and woolen, worsted and cotton finishing.

The fourth year is characterized by an endeavor to present certain subjects of a more applied nature in such a manner that the student's reasoning power and ability to apply the knowledge gained during the first three years may be developed to the fullest extent. The subject of engineering chemistry is introduced, and the work in the Dyeing and Analytical Laboratories is applied as far as possible to the actual requirements of the factory chemist and colorist. The student is given a thorough course in microscopy, photomicrography and the use of the various instruments, which often prove of vital importance in the advanced study of textile chemistry. During this fourth year the student devotes much time in the Organic Laboratory in the manufacture of dyestuffs. This is followed by some research work or original investigation, as time will permit. Upon this he must present a satisfactory thesis, or report, before receiving his degree.

For detailed description of the subjects see page 23.

Course IV. — Chemistry and Textile Coloring.

[For first year see page 15.]

Second Year. First Term. (Hours of Exercise.)

Adv. Inorganic Chemistry C–4 (30 hrs.).
Chemistry and Dyeing Lect. C–9 (30 hrs.).
Chemistry and Dyeing Lab. C–10 (60 hrs.).
Stoichiometry C–3 (15 hrs.).
Quantitative Analysis C–6 (195 hrs.).
Steam Engineering B–12 (45 hrs.).
Physics B–11 (45 hrs.).
Industrial History E–6 (15 hrs.).
Advanced German E–3 (30 hrs.).
Mathematics B–2 (45 hrs.).

Second Year. Second Term.

Adv. Inorganic Chemistry C–4 (30 hrs.).
Chemistry and Dyeing Lect. C–9 (15 hrs.).
Chemistry and Dyeing Lab. C–10 (130 hrs.).
Stoichiometry C–3 (15 hrs.).
Mathematics B–2 (45 hrs.).
Quantitative Analysis C–6 (140 hrs.).
Adv. Organic Chemistry C–5 (30 hrs.).
Physics B–11 (45 hrs.).
Industrial History E–6 (15 hrs.).
Advanced German E–3 (30 hrs.).
Steam Engineering B–14 (15 hrs.).

Third Year. First Term.

Adv. Textile Chemistry and Dyeing Lect. C–14 (30 hrs.).
Adv. Textile Chemistry and Dyeing Lab. C–14 (135 hrs.).
Industrial Chemistry C–12 (30 hrs.).
Quantitative Analysis C–7 (150 hrs.).
Adv. Organic Chemistry Lect. C–5 (30 hrs.).
Technical German C–21 (30 hrs.).
Wool Finishing H–1 (75 hrs.).
Economics E–7 (30 hrs.).

Third Year. Second Term.

Adv. Textile Chemistry and Dyeing Lect. C–14 (15 hrs.).
Adv. Textile Chemistry and Dyeing Lab. C–14 (72 hrs.).
Industrial Chemistry C–12 (30 hrs.).
Wool Finishing H–1 (72 hrs.).
Physical Chemistry C–8 (30 hrs.).
Technical German C–21 (30 hrs.).
Organic Laboratory C–15 (113 hrs.).
Quantitative Analysis C–7 (118 hrs.).
Economics E–7 (30 hrs.).

Fourth Year. First Term.

Physical Chemistry C–8 (45 hrs.).
Technical German C–21 (30 hrs.).
Engineering Chemistry C–16 (15 hrs.).
Adv. Textile Chemistry and Dyeing C–14 (30 hrs.).
Quantitative Analysis C–17 (15 hrs.).
Dyeing Laboratory C–14 (105 hrs.).
Organic Laboratory C–15 (90 hrs.).
Industrial Laboratory C–13 (45 hrs.).
Textile Testing G–3 (45 hrs.).
Thesis C–22 (90 hrs.).

Fourth Year. Second Term.

Organic Laboratory C–15 (102 hrs.).	Adv. Dyeing Conference C–19 (15 hrs.).
Microscopy C–18 (45 hrs.).	Technical German C–21 (30 hrs.).
Dyeing Laboratory C–14 (87 hrs.).	Engineering Chemistry C–16 (73 hrs.).
Physical Chemistry C–8 (15 hrs.).	Thesis C–22 (143 hrs.).

Course VI. — Textile Engineering.

This course is the four-year general textile course leading to the degree of Bachelor of Textile Engineering (B.T.E.), and aims especially to fit men, in the broadest possible manner, to meet the increasing demands of every branch of the textile industry for men with combined textile and technical preparation. The magnitude and scope of the textile and allied industries fully justify the most thorough technical training possible for all who aspire to leadership in this field.

The student is first thoroughly grounded in those fundamental principles of science upon which all industrial and engineering work rests. The foundation of his textile and technical training is in the subjects of mathematics, physics, chemistry, drawing, mechanics, mechanism, and technology of fibers, and their practical application.

Instruction is given in all of the various branches of textile manufacturing through lectures, recitations and laboratory work. A large proportion of his time is spent in well-equipped textile departments where he studies and operates all of the machinery required in the conversion of cotton and wool fiber into yarns and fabrics. This includes cotton, wool and worsted yarn manufacturing, designing, weaving, knitting, dyeing and finishing. In his last year the course in textile testing conducted by lectures and laboratory exercises acquaints the student in the modern methods of determining the physical characteristics of various fibers, yarns and fabrics. This instruction is given in a laboratory especially equipped in the automatic heat and humidity control that standard conditions may be maintained and that the characteristics may be studied under varying conditions of heat and moisture.

To properly equip the student to meet the varied engineering problems which confront the mill manager or executive, or to so train him that he may enter those industries closely allied to the textile, instruction is given by lecture and laboratory practice in the several branches of engineering.

Steam engineering considers the problems involved in steam generation and distribution for power, heating and manufacturing purposes includes the testing of laboratory and power plant equipment, and leads to the design of power plants. The course in electrical engineering includes a study of the generation and transmission of electrical power, the testing of direct and alternating current machinery, and the calibration of standard instrument used in testing. Lectures and laboratory work are given on photometry and the distribution of light from modern lighting units, thus acquainting the student with methods of modern practice.

Mill engineering familiarizes the student with mill design, construction, heating, lighting, humidification and fire protection. The arrangement of machinery and buildings for most efficient production and economical power distribution is also studied in detail.

During the fourth year the student is required to conduct an original investigation of some textile or allied problem, and to submit the results in the form of a satisfactory thesis before receiving his degree.

The broadening effect of such subjects as English, language, industrial history and economics is carried still further in this course by carefully planned courses in business administration, accounting, cost accounting, business and patent law.

For the student who may desire the breadth of technical training which this course offers, but who wishes to specialize on either cotton or wool manufacturing, two options are offered. A student may elect either of these optional courses and devote the scheduled time in manufacturing laboratories to the processes required in the utilization of that particular fibre in making yarns and fabrics. A student finishing the general course may in his fourth year substitute for certain ubjects extended work in some special subjects but such selections are subject to the approval of the head of the department.

Course VI. — Textile Engineering (General Course).

[For first year see page 15.]

Second Year. First Term. (Hours of Exercise.)

Chemistry and Dyeing Lect. C–9 (30 hrs.).
Physics B–11 (45 hrs.).
Mathematics B–2 (45 hrs.).
Machine Drawing B–10 (60 hrs.).
Steam Engineering B–12 (45 hrs.).
Power Weaving D–9 (30 hrs.).
Engineering Lab. B–16 (45 hrs.).
Machine Shop Practice B–17 (45 hrs.).
Cotton Yarn Mfg. F–1 (45 hrs.).
Wool Yarn Mfg. G–1 (90 hrs.).
Language E–3, 5 (30 hrs.).
Industrial History E–6 (15 hrs.).

Second Year. Second Term.

Physics B–11 (45 hrs.).
Mathematics B–2 (45 hrs.).
Machine Drawing B–10 (72 hrs.).
Steam Engineering B–13 (30 hrs.).
Machine Shop Practice B–17 (42 hrs.).
Yarn Mfg. F–2 and G–2 (117 hrs.).
Language E–3, 5 (30 hrs.).
Industrial History E–6 (15 hrs.).
Power Weaving D–9 (27 hrs.).
Chemistry and Dyeing Lect. C–9 (15 hrs.).
Graphic Statics B–5 (30 hrs.).
Engineering Lab. B–16 (42 hrs.).

Third Year. First Term.

Electrical Engineering B–20 (75 hrs.).
Machine Shop Practice B–17 (45 hrs.).
Engineering Lab. B–16 (45 hrs.).
Yarn Mfg. F–2 and G–2 (90 hrs.).
Strength of Materials B–18 (30 hrs.).
Power Weaving D–10 (45 hrs.).
Mathematics B–2 (30 hrs.).
Mill Engineering B–21 (45 hrs.).
Wool Finishing H–1 (75 hrs.).
Economics E–7 (30 hrs.).

Third Year. Second Term.

Hydraulics B–15 (15 hrs.).
Electrical Engineering B–20 (72 hrs.).
Mill Engineering B–21 (45 hrs.).
Machine Shop Practice B–17 (30 hrs.).
Yarn Mfg. F–2 and G–2 (143 hrs.).
Wool Finishing H–1 (72 hrs.).
Power Weaving D–10 (43 hrs.).
Mathematics B–2 (30 hrs.).
Strength of Materials B–18 (30 hrs.).
Economics E–7 (30 hrs.).

Fourth Year. First Term.

Yarn Mfg. and Knitting F–2, 3 and G–2 (132 hrs.).
Mill Engineering B–23 (72 hrs.).
Electrical Engineering B–20 (72 hrs.).
Cotton Finishing H–2 (30 hrs.).
Textile Testing G–3 (42 hrs.).
Power Plants B–19 (30 hrs.).
Business Administration B–24 (45 hrs.).
Elements of Accounting B–25 (45 hrs.).
Thesis (42 hrs.).
Electives B–28.

Fourth Year. Second Term.

Yarn Mfg. and Knitting F–2, 3 and G–2 (90 hrs.).
Mill Engineering B–23 (72 hrs.).
Electrical Engineering B–20 (72 hrs.).
Cotton Finishing H–2 (72 hrs.).
Power Plants B–19 (30 hrs.).
Business Administration B–24 (30 hrs.).
Cost Accounting B–26 (45 hrs.).
Business Law B–27 (15 hrs.).
Thesis (84 hrs.).
Electives B–28.

Course VI. — Textile Engineering (Cotton Option).

[For first year see page 15.]

Second Year. First Term. (Hours of Exercise.)

Chemistry and Dyeing Lect. C–9 (30 hrs.).
Physics B–11 (45 hrs.).
Mathematics B–2 (45 hrs.).
Machine Drawing B–10 (57 hrs.).
Engineering Lab. B–16 (42 hrs.).
Steam Engineering B–12 (45 hrs.).
Machine Shop Practice B–17 (42 hrs.).
Cotton Yarn Mfg. F–1 (132 hrs.).
Language E–3, 5 (30 hrs.).
Industrial History E–6 (15 hrs.).
Power Weaving D–9 (27 hrs.).

Second Year. Second Term.

Physics B–11 (45 hrs.).
Mathematics B–2 (45 hrs.).
Machine Drawing B–10 (72 hrs.).
Steam Engineering B–13 (30 hrs.).
Machine Shop Practice B–17 (42 hrs.).
Cotton Yarn Mfg. F–2 (117 hrs.).
Engineering Lab. B–16 (42 hrs.).

Power Weaving D–9 (27 hrs.).
Language E–3, 5 (30 hrs.).
Industrial History E–6 (15 hrs.).
Chemistry and Dyeing Lect. C–9 (15 hrs.).
Graphic Statics (30 hrs.).

Third Year. First Term.

Electrical Engineering B–20 (72 hrs.).
Mill Engineering B–21 (45 hrs.).
Cotton Yarn Mfg. F–2 (87 hrs.).
Cotton Design D–6, 7 (72 hrs.).
Power Weaving D–10 (30 hrs.).

Engineering Lab. B–16 (42 hrs.).
Mathematics B–2 (30 hrs.).
Strength of Materials B–18 (30 hrs.).
Economics E–7 (30 hrs.).
Cotton Finishing H–2 (72 hrs.).

Third Year. Second Term.

Hydraulics B–15 (15 hrs.).
Electrical Engineering B–20 (72 hrs.).
Mill Engineering B–21 (45 hrs.).
Cotton Yarn Mfg. F–2 (72 hrs.).
Cotton Design D–6, 7 (30 hrs.).
Machine Shop Practice B–17 (30 hrs.)

Power Weaving D–10 (84 hrs.).
Mathematics B–2 (30 hrs.).
Strength of Materials B–18 (30 hrs.).
Economics E–7 (30 hrs.).
Cotton Finishing H–2 (72 hrs.).

Fourth Year. First Term.

Mill Engineering B–23 (84 hrs.).
Electrical Engineering B–20 (72 hrs.).
Cotton Yarn Mfg. and Knitting F–2, 3 (120 hrs.).
Power Plants B–19 (30 hrs.).
Textile Testing G–3 (42 hrs.).

Cotton Design D–6, 7 (30 hrs.).
Business Administration B–24 (45 hrs.).
Elements of Accounting B–25 (45 hrs.).
Thesis (42 hrs.).
Electives B–28.

Fourth Year. Second Term.

Yarn Mfg. and Knitting F–2, 3 (132 hrs.).
Mill Engineering B–23 (72 hrs.).
Electrical Engineering B–20 (72 hrs.).
Power Plants B–19 (30 hrs.).
Business Administration B–24 (30 hrs.)

Cotton Design D–6, 7 (30 hrs.).
Cost Accounting B–26 (45 hrs.).
Business Law B–27 (15 hrs.).
Thesis (84 hrs.).
Electives B–28.

Course VI. — Textile Engineering (Wool Option).

[For first year see page 15.]

Second Year. First Term. (Hours of Exercise.)

Chemistry and Dyeing Lect. C–9 (30 hrs.).
Physics B–11 (45 hrs.).
Mathematics B–2 (45 hrs.).
Machine Drawing B–10 (57 hrs.).
Engineering Lab. B–16 (42 hrs.).
Steam Engineering B–12 (45 hrs.).

Machine Shop Practice B–17 (42 hrs.).
Woolen and Worsted Yarn Mfg. G–1 (117 hrs.).
Language E–3, 5 (30 hrs.).
Industrial History E–6 (15 hrs.).
Power Weaving D–9 (42 hrs.).

Second Year. Second Term.

Physics B–11 (45 hrs.).
Mathematics B–2 (45 hrs.).
Machine Drawing B–10 (72 hrs.).
Steam Engineering B–13 (30 hrs.).
Machine Shop Practice B–17 (42 hrs.).
Wool Yarn Mfg. G–2 (117 hrs.).
Engineering Lab. B–16 (42 hrs.).

Power Weaving D–9 (27 hrs.).
Language E–3, 5 (30 hrs.).
Industrial History E–6 (15 hrs.).
Chemistry and Dyeing Lect. C–9 (15 hrs.).
Graphic Statics (30 hrs.).

THIRD YEAR. FIRST TERM.

Electrical Engineering B–20 (72 hrs.).	Wool Finishing H–1 (72 hrs.).
Machine Shop Practice B–17 (45 hrs.).	Power Weaving D–10 (42 hrs.).
Mathematics B–2 (30 hrs.).	Engineering Lab. B–16 (42 hrs.).
Mill Engineering B–21 (45 hrs.).	Strength of Materials B–18 (30 hrs.).
Wool Yarn Mfg. G–2 (102 hrs.).	Economics E–7 (30 hrs.).

THIRD YEAR. SECOND TERM.

Hydraulics B–15 (15 hrs.).	Wool Finishing H–1 (72 hrs.).
Electrical Engineering B–20 (72 hrs.).	Power Weaving D–10 (84 hrs.).
Mill Engineering B–21 (45 hrs.).	Mathematics B–2 (30 hrs.).
Machine Shop Practice B–17 (30 hrs.).	Strength of Materials B–18 (30 hrs.).
Economics E–7 (30 hrs.).	Electives B–28.
Wool Yarn Mfg. G–2 (102 hrs.).	

FOURTH YEAR. FIRST TERM.

Mill Engineering B–23 (84 hrs.).	Textile Testing G–3 (42 hrs.).
Electrical Engineering B–20 (72 hrs.).	Business Administration B–24 (45 hrs.).
Worsted Yarn Mfg. G–2 (120 hrs.).	Elements of Accounting B–25 (45 hrs.).
Woolen and Worsted Design D–6, 7 (30 hrs.).	Power Plants B–19 (30 hrs.).
	Thesis (42 hrs.).

FOURTH YEAR. SECOND TERM.

Mill Engineering B–23 (72 hrs.).	Business Administration B–24 (30 hrs.).
Electrical Engineering B–20 (72 hrs.).	Cost Accounting B–26 (45 hrs.).
Yarn Mfg. and Knitting G–2 and F–2 (132 hrs.).	Business Law B–27 (15 hrs.).
Woolen and Worsted Designs D–6, 7 (30 hrs.).	Power Plants B–19 (30 hrs.).
	Thesis (84 hrs.).
	Electives B–28.

SUBJECTS OF INSTRUCTION.

TEXTILE ENGINEERING DEPARTMENT — B.

Mathematics (Algebra, Trigonometry, Elements of Analytical Geometry) — B-1. Preparation: Admission Requirements.

This subject is given in the first year with the view of consolidating the separate branches of mathematics that have been given in previous years. The progress of the school has been such as to necessitate the introduction of higher algebra and trigonometry in the early part of the first term, and hence, as in other technical schools, it has resulted in a combined course. This course is presented by means of lectures, textbook, class and problem work, and consists essentially of the following: graphical representation, logarithms, slide rule, trigonometry, theory of equations, significant figures, and plotting of scientific data, straight line equations, equation of parallel and perpendicular lines, equations of the conic sections. [All courses.]

Mathematics (Analytical Geometry, Differential Calculus, Integral Calculus) — B-2. Preparation: B-1.

This course is a continuation of the work of the first year, and treats of the following subjects: formulæ of differentiation, conic sections, transformation of co-ordinates, maxima and minima, direction of curves, center and radius of curvature, problems on differential calculus, elements of integral calculus, integration as a summation, and plane areas. The above are treated in both rectangular and polar co-ordinates. Then follow formulæ of integration, integration by parts, integration by substitution, successive integration, evaluation of integrals, center of gravity, center of pressure, total pressure, moment of inertia. [Courses IV, VI.]

Mechanics — B-3. Preparation: Admission Requirements. Taken simultaneously with B-1.

This subject is required as a necessary preparation for all courses, and sixty hours of lecture and recitation time are devoted to it during the first term of the first year. The fundamental principles of this subject are considered absolutely essential to a thorough understanding of the operation of all machinery, textile or otherwise. Some of the topics treated in this course are linear and angular velocity, uniform and accelerated motion, mass, momentum, inertia, effect of force in producing motion, centrifugal force, work, power, energy, principle of moments and its applications, parallelogram and triangle of forces with applications, resolution and composition of forces, the mechanical principles represented by the wheel and axle, differential pulley block, common pulley blocks, jackscrew, worm and wheel, and inclined plane. [All courses.]

Mechanism — B-4. Preparation: B-1 and B-3.

This subject is also deemed to be one of those absolutely essential to every student's preparation for the work of the following years, and sixty hours during the second term of the first year are allowed for it. Whereas the principles studied are of general application, textile machinery in particular furnishes an unusually large variety of specific examples, and frequent reference is made to these in the development of the course. Some of the important topics covered are gearing and gear train design, belting and pulley calculations, cone and stepped pulley design, cam design, linkages, epicyclic gear trains, and intermittent motion devices. [All courses.]

Graphic Statics — B-5. Preparation: B-1 and B-3.

The work in this course is presented by lecture and recitations. First are considered mathematical and graphical conditions for equilibrium for any system of forces, and the subjects of center of gravity and funicular polygons are introduced. Then follow problems on bridge and roof trusses under various conditions of dead, live, wind and snow loading. [Course VI.]

Mechanical Laboratory — B-6. Preparation: B-1 and B-3. Taken simultaneously with B-4.

This work is given during the second term of the first year, and is supplementary to the course in Mechanics and Mechanism. Especial importance is attached to the demonstration of the fundamental principles of these subjects. Some of the experiments and tests made in this course are as follows: —

Determination of coefficient of friction; proof of principle of moments; proof of principle of work; efficiency test of various hoisting and lifting appliances, such as tackle and fall, worm block, differential and triplex blocks, jackscrews, wedges, etc.; experimental proofs of the principles of graphic statics; efficiency tests on belt transmission, including measurement of belt tensions, coefficient of friction, slip, etc.

Tests on various types of absorption dynamometers; calibration of transmission dynamometer; power measurements on textile machinery with differential dynamometer; measurement of friction of steam engine. [Course VI.]

Mechanical Drawing — B-7. Preparation: Admission Requirements. Taken simultaneously with B-3.

This course is taken during the first year, and consists of work in the drawing room supplemented by lectures. This subject is considered of the greatest importance as a preparation for the student's future work, and the practical usefulness of drawing of this character is fully emphasized. The course is systematically laid out covering in order the following divisions: —

Care and use of drawing instruments; geometrical constructions; elements of projections and descriptive geometry; isometric projection; developments with practical applications; sketching practice on machine details. [All courses.]

Machine Drawing — B-8. Preparation: B-7.

This work is the continuation of Mechanical Drawing, and is pursued throughout the second term of the first year. This work is wholly of a practical character, and includes sketching from the textile machinery details, working scale detail and assembly drawing, tracing and blue printing. The rudiments of machine design to supplement the work in strength of materials is also given. [Courses I, II, III, VI.]

Machine Drawing — B-9. Preparation: B-7.

For students electing the Chemistry and Textile Coloring course in the second term of the first year a course of machine drawing is given similar to B–8, except that it is not as extensive and is concluded in thirty hours. [Course IV.]

Machine Drawing — B-10. Preparation: B-4, B-7, B-8.

During the second year the work in Machine Drawing is devoted to advanced graphical mechanism problems. The data for all of these problems are in every case taken directly from some of the textile machines that the students meet in in other departments. These problems include cam designs for builder motions, mule scroll layouts, Scaife builder motion analysis, fly frame cone design, mule quadrant motion, analysis of camless winder, and a number of others of similar character. [Courses I, II, III, VI.]

Physics — B-11. Preparation: B-1 and B-3.

This course is given during the second year, and serves especially as a preparation for hydraulics, electricity and optics. The subject is presented by means of lectures, recitations, problems and reference books. The lectures deal chiefly with the application of the various physical laws and principles, with a view to their adaption to the above subjects, while the reference books are used to supplement the lectures. The subjects taken up are essentially as follows: gravitation, moving bodies, mechanics, elasticity, hydrostatics, elements of hydraulics, properties of fluids and gases, and the theory of sound. These subjects are followed by a series of lectures on heat phenomena, dealing with the generation of heat, thermometry, calorimetry, transfer of heat, its effect on solids, liquids and gases.

The latter part of the course is devoted to the discussion of the laws governing the nature, propagation and transmission of light waves, special stress being laid on interference, reflection and refraction, mirrors, lenses, microscope, spectroscope and photometer. Particular attention is given to the color effects produced by the combination of different colors in connection with Maxwell's Color Diagram and the Young-Helmholtz Theory of Color Sensation. During the last part of the course the principles of electricity and magnetism are taken up in detail. [All courses.]

Steam Engineering — B-12. Preparation: B-1, B-3, B-4.

The purpose of this course is to familiarize the student with the principles of elementary thermodynamics, the properties of steam, mechanical mixtures, combustion of fuels, types of boilers, and the auxiliaries of the modern boiler house. The course consists of forty-five exercises given in the first term of the second year. The lectures and recitations are supplemented with illustrative problems assigned for home preparation. [All courses.]

Steam Engineering — B-13. Preparation: B-12.

This course is a continuation of B–12, and consists of thirty hours of lectures and recitations given in the second term of the second year of the Textile Engineering course. The subjects developed are the kinematics of reciprocating steam engines, steam turbines and gas engines. Special attention is given to the mechanical principles on which the steam engine operates, with detail discussion of the valve gear and governing devices, and the various diagrams used for studying the same. Consideration is given to the underlying heat theory and to the details of construction of the various parts of the machines. During the latter part of the course the historical development, classification and types of turbines and gas engines are discussed. [Course VI.]

Steam Engineering — B-14. Preparation: B-12.

This course consists of fifteen lectures and is supplementary to Course B-12. Its aim is to give those students who do not take the Engineering course a general knowledge of the steam engine, steam turbine and gas engine, and their auxiliaries. One exercise is devoted to an engine test to demonstrate the practical use of the indicator and the advantages of condensing. [Courses I, II, III, IV.]

Hydraulics — B-15. Preparation: B-2 and B-11.

This subject is presented by means of lectures covering the principles of hydraulics, including hydrostatics, measurements of flow of water through orifices, pipes, nozzles and over weirs. The different types of turbines are studied with results of tests and rating tables. [Course VI.]

Engineering Laboratory — B-16. Preparation: B-12.

The principles underlying the subjects of steam engineering, hydraulics and thermodynamics are demonstrated in a practical manner in the work in the Engineering Laboratory. Greater importance is attached to the development of initiative and responsibility in the student than the mere accomplishment of a large number of carefully planned tests. The character of this work is indicated by the following list of experiments and tests: —

Calibration of gauges, thermometers, indicators, anemometers, tachometers and other measuring instruments; experiments on flow of steam; calorimeter tests; radiation tests and pipe-covering tests; injector and ejector tests; engine tests, condensing and non-condensing; steam pump tests; surface condenser tests; valve setting; boiler testing; tests on heating and ventilating fans, both motor and engine driven; pump tests, triplex and centrifugal; air-compressor tests; flue gas analysis; steam turbine tests; condensing, non-condensing and low pressure; complete steam plant testing; gas engine testing. [Course VI.]

Machine Shop Practice — B-17. Preparation: B-3 and B-4.

Systematic instruction is given in the most approved methods of machine shop practice, the object being to familiarize the student with the proper use of hand and machine tools, and the characteristics of the different materials worked. Particular attention is given to the form, setting, grinding and tempering of tools and the mechanism of the different machines involving certain speeds, feeds, etc. The course is so planned that the instruction in each typical operation shall conform as nearly as possible to commercial machine-shop practice on textile machinery. The list of tools which appears under "Equipment" in this Bulletin gives an idea of the scope of the work, which includes chipping and filing, tool grinding and tempering, straight and taper turning, screw cutting, drilling and boring, planer work; milling machine work, including gear cutting. Instruction is also given in the use of woodworking tools, both hand and machine, and in forging. [Course VI.]

Strength of Materials — B-18. Preparation: B-2, B-4, B-5.

This subject consists of sixty exercises given in the third year of the Textile Engineering course, and in which are discussed, as fully as time permits, such topics as stress, strain, methods of testing materials, bending moments, shearing force, beam design, column design, torsion, design of shafts, compound beams and columns, combined stresses, etc. The subject is preparatory to the work in Mill Engineering of both the third and fourth years, where its practical value and application are clearly demonstrated. [Course VI.]

Power Plants — B-19. Preparation: B-13.

This course, which consists of lectures given during the fourth year, takes up the fundamental consideration involved in the planning of a power plant for a textile mill. A standard textbook is used in connection with the lectures, and the problems are taken largely from plans of existing modern plants. The choice of type and size of units for certain conditions are given particular attention. [Course VI.]

Electrical Engineering — B-20. Preparation: B-11.

The elementary principles of electricity and magnetism are considered in the lecture course of physics. Their development and application are taken up in this course in a detailed study of the means used to generate, transmit and transform electrical energy to meet the requirements of textile machinery and plants. This involves the theory of direct and alternating current generators, motors, instruments, as well as the various phenomena associated with them.

The laboratory course includes a study of instruments and methods employed in general electrical power testing. Attention is given to various lighting units, their particular properties and relative values in meeting the special problems of illumination in textile mills. [Course VI.]

Electricity — B-20a. Preparation: B-11.

This is a short course given in the third year of the manufacturing courses, and consists of thirty lectures covering briefly and in a general way the theory of direct and alternating current generators and motors. [Courses I, II, III.]

Mill Engineering — B-21. Preparation: B-2, B-4, B-5, B-10, B-18 taken simultaneously.

Mill Engineering, as presented in thirty lectures during the third year of the Textile Engineering course, consists of a discussion of the following topics: the selection of a site for a manufacturing plant; the exploration of the sub-soils for the footing course of the foundation; wood, concrete and sheet steel piling; design of walls, columns, beams, floors, windows, doors, stairways and roofs.

Sixty hours of drawing room and laboratory practice are devoted to plane surveying, contour plotting, cut and fill calculations, setting of batter boards, alignment of shafting and the study from blue prints of mills of slow-burning construction. [Course VI.]

Mill Engineering — B-22. Preparation: B-1, B-4, B-10.

Mill Engineering, as presented in thirty lectures during the third year of the diploma courses, is largely general in its nature and includes only parts of Course B-21. [Courses I, II, III.]

Mill Engineering — B-23. Preparation: B-3, B-4, B-10, B-17.

This work, given in the fourth year of the Textile Engineering course, covers a wide range of subjects and is of the most practical character possible. All of the student's previous work in engineering and his knowledge of the textile processes are here brought together in the consideration of the larger problems of mill design, construction and organization. After a detailed study has been made of the most modern types of mill buildings, including all calculations and drawings, the student is given the problem of laying out and completely designing a textile mill so far as time permits.

The modern methods of power transmission and the proper arrangement of textile machinery are also given careful consideration. The problems are in every case taken from actual conditions in mills already built or in process of construction. The question of mill heating, ventilation, lighting, humidification and fire protection is also studied, and the time spent in the drawing room enables the student to work out nearly all of the more important problems involved in the design of an entire textile mill plant. The close relation existing between proper plant design and economical production is also considered. [Course VI.]

Business Administration — B-24. Preparation: B-1 and E-7.

In recognition of the great advances which have been recently made towards better methods of management, and of the possibilities which may result from its application to the textile industry, a course in business administration has been established to enable the student to understand and apply the principles and details of modern management. The instruction in this course begins with a consideration of the factory location and design and their effect on efficiency of production, after which the proper form of organization for manufacturing establishments is discussed in detail, together with organization charts and records.

This is followed by a study of the details of the work of the various departments, such as purchasing, manufacturing, planning, etc., and includes such topics as purchasing systems, storekeeping, perpetual inventories, warehousing, scheduling, routing, tracing, timekeeping, motion studies, time studies, mnemonic symbolizing, graphical records, wage systems, etc. Consideration is also given to the important relation of psychology to efficient management. The work is further supplemented by visits to plants where methods of production and management can be observed at first hand by the students. [Course VI.]

Elements of Accounting — B-25. Preparation: B-1 and E-7.

The purpose of the course in accounting is to acquaint the student with modern methods of accounting for mercantile and manufacturing businesses. At the same time it gives him a much-needed knowledge of such common elementary business transactions as are involved in the use of checks, drafts, notes, vouchers, bonds and stocks.

It is not the purpose of the course to make the student a proficient bookkeeper or accountant, but the nature of the work necessitates a basic knowledge of double-entry bookkeeping and of the functions of ledger accounts. This is developed in practice in the following manner: During the summer preceding the fourth year the student is required to work up a simple bookkeeping set, thus saving valuable time during the school year and effectively preparing the ground for the instruction work.

The course includes a study of the balance sheet and profit and loss statement, and their construction in proper form. Attention is given to the principles of balance sheet valuation, and to such topics as depreciation in all its phases, sinking fund reserves, and the accounting for bond and stock issues. [Course VI.]

Cost Accounting — B-26. Preparation: B-25.

The major portion of the time scheduled for accounting in the second term of the fourth year of the Textile Engineering course is devoted to a study of this importance topic. It is designed to give the student a knowledge of the various cost methods in use at the present time, and involves a thorough discussion of methods of handling and accounting for raw materials, direct labor, and the distribution of overhead expenses. To supplement the instruction, the student is required to work up a cost accounting set. [Course VI.]

Business Law — B-27. Preparation: E-7.

Under this subject are given lectures, supplemented by the use of a suitable text, on the law governing contracts, negotiable instruments, sales, bills of lading, real estate and corporation. [Course VI.]

Electives — B-28.

Students in the fourth year of the Textile Engineering course will be permitted to elect certain textile subjects as substitutes for part of the time scheduled for engineering subjects. Thus a student is offered an opportunity for specialized study along such lines as will prove most beneficial to him at that time. The selection of elective studies is subject to the approval of the head of the Textile Engineering department and to the possibility of arranging for the same. [Course VI.]

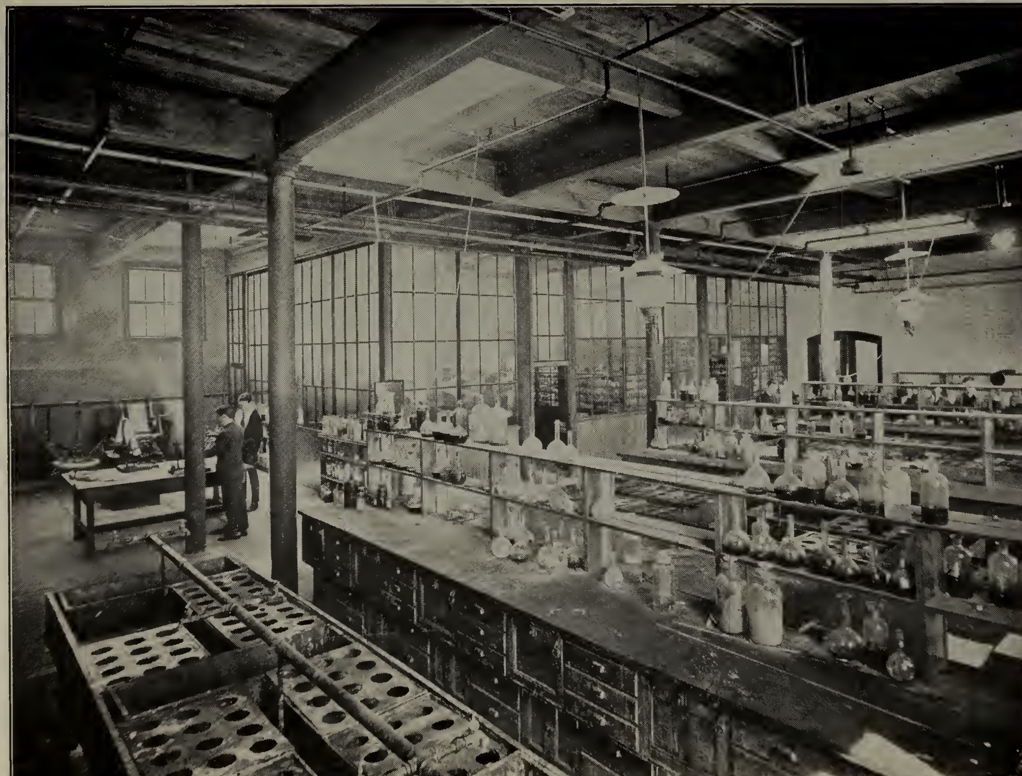
CHEMISTRY AND DYEING DEPARTMENT — C.

Elementary Chemistry (Inorganic and Organic Chemistry) — C-1. Preparation: Admission Requirements.

Instruction in Elementary Chemistry extends through the first year, and includes lectures, recitations and a large amount of individual laboratory work upon the following subjects: —

Chemical Philosophy. — Chemical action, chemical combination, combining weights, atomic weights, chemical equations, acids, bases, salts, Avogadro's law, molecular weights, formula, valence, periodic law, etc.

Non-metallic Elements. — Study of their occurrence, properties, preparations, chemical compounds, etc.



Experimental Dyeing Laboratory.

Metallic Elements. — Study of their occurrence, properties, metallurgy, chemical compounds, etc.

The students take up, as thoroughly as time will permit, the qualitative detection of the more common metals and non-metals, with practical work.

The Hydrocarbons and their Derivatives. — Study of their occurrence, properties, preparations and uses. This work, although elementary in character, is of sufficient breadth to prepare the student understandingly for the work with artificial dyestuffs which follows. [All courses.]

Qualitative Analysis — C-2. Preparation: C-1 taken simultaneously.

Qualitative Analysis is studied during the second term of the first year. The work consists of lectures, recitations and laboratory work. The student must become familiar with the separations and the detections of the common metals and acids by the analysis of a satisfactory number of solutions, salts, alloys and pigments. At intervals during the term short laboratory tests are given as well as the regular written examinations.

No pains are spared to make the course as valuable to the student as possible, and to encourage only thorough and intelligent work.

When sufficiently advanced, students take up the examination of various products with which the textile chemist must be familiar, such as testing mordanted cloths, pigments and the various dyeing reagents.

During the latter part of this course a certain amount of time is devoted to the preliminary operations of quantitative analysis, such as the precipitation and washing of such substances as barium sulphate, magnesium ammonium phosphate and calcium oxalate, although no weighings or actual determinations are made.

A student's marks in this subject depend as much upon the neatness and care used in manipulation as upon the actual results obtained. [Course IV.]

Stoichiometry — C-3. Preparation: B-1, C-1.

This subject is taken during the second half of the first year, and is continued throughout the second year an as adjunct to Quantitative Analysis. The application of the metric system is thoroughly studied, and problems are worked involving the expansion and contraction of gases, determination of empirical formulæ, combining volume of gases and quantitative analysis. [Course IV.]

Advanced Inorganic Chemistry — C-4. Preparation: C-1.

The whole subject of Inorganic Chemistry is reviewed during the second year, and many advanced topics are introduced which were necessarily omitted from the first-year course in General Chemistry. [Course IV.]

Advanced Organic Chemistry — C-5. Preparation: C-1.

In this course, which consists of lectures and recitations, the principles of organic substitution and synthesis are thoroughly discussed, and as many illustrations are used as time will permit, particularly such as are applied in the arts. The aliphatic series of hydrocarbons and their derivatives are studied for about twenty weeks, the remainder of the time being devoted to the benzine series. The aim of the course is to lay a broad foundation for the study of the chemistry of the artificial dyestuffs. Students are required to work out problems in the synthesis of various compounds, in order to become familiarized with equation writing. [Course IV.]

Quantitative Analysis — C-6. Preparation: C-2, C-3.

During the second year the principles of analytical work are thoroughly taught, the work being based on Talbot's "Quantitative Chemical Analysis." Gravimetric analysis is studied during the first term, and volumetric analysis during the second term. The samples analyzed include salts, ores, minerals, bleaching powder and alkalies. Frequent recitations are held for the discussion of methods and the solution of stoichiometrical problems. Students are encouraged to read the standard works and magazines on chemical subjects, in order to cultivate broad views of the science. [Course IV.]

Quantitative Analysis — C-7. Preparation: C-6.

This course consists chiefly of technical analysis, the principal consideration being the analysis of water, alum, ammonia, soaps, coal, indigo, tannin and the ultimate analysis of organic compounds, as well as the examination of acids, alkalies, oils, scouring materials and such substances as starches, gums and other thickeners, and the detection of adulterants.

No pains are spared to give the student the benefits of all the latest researches along the lines of industrial analytical methods, and original work is encouraged in all. [Course IV.]

Physical Chemistry — C-8. Preparation: C-4, C-5, B-11.

This subject is studied during the third and fourth years. It includes the principles of calorimetry, specific heat, vapor density, the various methods of determining molecular weights, laws of solutions, electrolytic dissociation, theories of precipitation, thermo-chemistry, surface tension, etc. The student is required to work out a large number of problems introduced by the subject. [Course IV.]

Textile Chemistry and Dyeing — C-9. Preparation: C-1, B-4, B-7.

The outline of the lecture course which is given during the first term of the second year is as follows: —

Technology of Vegetable Fibers. — Cotton, linen, jute, hemp, china grass. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Animal Fibers. — Wool, mohair, silk. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Artificial Fibers. — Study of the various forms of artificial silk, the process of manufacture, their properties and action with chemicals, acids and heat.

Operations Preliminary to Dyeing. — Bleaching of cotton and linen; wool-scouring; bleaching, fulling and felting of wool; carbonizing; silk-scouring and bleaching; action of soap.

The bleaching of cotton cloth, yarn and raw stock is studied at length with detailed description of the various forms of kiers and machinery used; also the action of the chemicals used upon the material, and the various precautions that must be taken in order to insure successful work.

Under this heading is also included an exhaustive study of the reagents used in the emulsive wool-scouring process, and their action upon the fiber under various conditions; also the most successful of the solvent methods for degreasing wool.

Water and its Application in the Textile Industry. — Impurities present, methods for detection, their effect during the different operations of bleaching, scouring, dyeing and printing, and the methods used for their removal or correction.

The important subject of boiler waters is also studied under this heading, with a full discussion of the formation of boiler scale, its disastrous results, and the methods by which it may be prevented.

Mordants and Other Chemical Compounds used in Textile Coloring and classified as Dyestuffs. — Theory of mordants, their chemical properties and application, aluminum mordants, iron mordants, tin mordants, chromium mordants, organic mordants, tannin materials, soluble oil, fixing agents, leveling agents, assistants, and numerous other compounds, not dyestuffs, that are extensively used in the textile industry.

Under this heading are included the definitions of various terms and classes of compounds used by textile colorists, such as color lakes, pigments, fixing agents, developing agents, mordanting assistants, mordanting principles and leveling agents.

Theory of Dyeing. — A discussion of the chemical, mechanical, solution and absorption theories, and the various views that have been advanced by different investigators of the chemistry and physics of textile coloring processes.

Under this heading are discussed the general methods of classifying dyestuffs and the definitions of such terms as textile coloring, dyeing, textile printing, substantive and adjective dyestuffs, monogenetic and polygenetic dyestuffs.

Natural Organic Coloring Matters. — Properties and application of indigo, logwood, catechu or cutch, Brazil wood, cochineal, fustic, tumeric, madder, quercitron bark, Persian berries, and other natural dyestuffs that have been used within recent years by textile colorists.

Mineral Coloring Matters. — Under this heading are discussed the properties of such inorganic coloring matters and pigments as chrome yellow, orange and green, Prussian blue, manganese brown, and iron buff.

Artificial Coloring Matters. — General discussion of their history, nature, source, methods of manufacture, methods of classification and their application to all fibers.

Special study of basic coloring matters, phthalic anhydride colors, including the eosins and phloxines; acid dyestuffs, Janus, direct cotton, sulphur and mordant colors, including the alizarines and other artificial coloring matter requiring metallic mordants; mordant acid and insoluble azo colors, developed on the fiber; reduction vat colors, aniline black and other artificial dyestuffs not coming under the above heads.

As each class of dyestuffs is taken up, the details of the methods of applying them upon all the different classes of fabrics and in all the different forms of dyeing machines are thoroughly discussed; also the difficulties which may arise in their application, and the methods adopted for overcoming them.

Machinery used in Dyeing. — A certain amount of time is devoted to the description of the machinery used in the various processes of textile coloring, which is supplemented as far as possible by the use of charts, diagrams and lantern slides.

Most of the important types of dyeing machines are installed within the dyehouse of the school, and the students can be taken directly from the lecture room and shown the machines in actual operation. [All courses.]

Dyeing Laboratory — C-10. Preparation: C-9 taken simultaneously.

Besides lectures and recitations upon the subject of Textile Chemistry and Dyeing, practical laboratory work is required. By the performance of careful and systematic experiments the student learns the nature of the various dyestuffs and mordants, their coloring properties, their action under various circumstances, and the conditions under which they give the best results. The more representative dyestuffs of each class are applied to cotton, wool and silk, and each student is obliged to enter, in an especially arranged sample book, a specimen of each of his dye trials with full particulars as to the conditions of experiment, percentage of compounds used, time, temperature of dye bath, etc.

For convenience and economy most of the dye trials are made upon small skeins or swatches of the required materials, but from time to time students are required to dye larger quantities in the full-sized dyeing machines which are described elsewhere.

By the use of a small printing machine the principles of calico printing are illustrated, and by means of the full-sized dyeing machines and vats the practical side of the subject is studied. It is the constant endeavor of those in charge to impart information of a theoretical and scientific character that will be of value in the operation of a dyehouse. [Course IV.]

Industrial Chemistry (Lecture) — C-12. Preparation: C-4, C-5.

During the whole of the third year lectures and recitations are held in industrial chemistry, the course in general following "Thorpe's Outline of Industrial Chemistry." Particular attention is paid to those subjects which are of special interest to the textile chemist, as oils, soaps, gas and coal-tar industry, building materials, and the manufacture on a large scale of important chemical compounds, such as the common acids and alkalies, bleaching powders, various mordants, etc. The course is illustrated as far as possible with specimens, diagrams and charts, and the students are given an opportunity to visit some of the industrial establishments in the vicinity of Lowell and Boston. [Course IV.]

Industrial Chemistry (Laboratory) — C-13. Preparation: C-6, C-12.

Special attention has been given to this subject because it is considered extremely important in the study of chemistry in general, and of textile chemistry in particular. During the third year considerable time is spent in the laboratory in the actual

manufacture, from raw materials, of the chemical compounds used in textile work. Each student is required to make careful record of all of the crude materials used, as starting points, and to carry the various processes through carefully with the view of producing as great and pure a yield of each substance as possible. Industrial chemistry not only involves the application of the principles of both inorganic and organic chemistry, but of analytical work as well, for the purity of the compounds produced must be tested after their manufacture.

In addition to the general work in this subject, each student is required to make a special study of the manufacture of some chemical from raw materials in considerable quantity (20 to 25 pounds), making a complete quantitative analysis of all raw materials used and of the finished product, accounting for everything throughout the process, with the object of producing as near the theoretical yield as possible. The student is charged with the amount of raw material at market prices, and the finished product is bought back by the school.

Recently much new apparatus has been added to the Industrial Chemistry Laboratory, and it is now believed to be one of the most complete of its kind. The present equipment allows a comparatively large quantity of material to be handled at one time. [Course IV.]

Advanced Textile Chemistry and Dyeing — C-14. Preparation: C-9, C-10.

This is a continuation of the Textile Chemistry and Dyeing Course of the second year, and includes a review of the second year's work in this subject, with the introduction of many advanced considerations, and, in addition, the following subjects: —

Classification and Construction of Artificial Dyestuffs. — A study from a more advanced standpoint of the classification and constitution of artificial dyestuffs, including the various methods used in their production, also the orientation of the various groups which are characteristic of these compounds, and their effect on the tinctorial power of dyestuffs.

The object of this study is to give the student a more complete knowledge of the artificial dyestuffs, from the color manufacturer's point of view, which will prove of particular value to those who intend later to enter the employ of dyestuff manufacturers or dealers.

Color Matching and Color Combining. — A study of that portion of physics which deals with color and the many color phenomena of interest to the textile colorist. The lecture work is supplemented with the practical application of the spectroscope and tintometer, and much practice in the matching of dyed samples of textile material.

The primary colors both of the scientist and textile colorist, the results of combining coloring lights and pigments, and such subjects as color perception, color contrast, purity of color, luminosity, hue, color blindness, dichroism, fluorescence, and the effect of different kinds upon dyed fabrics, are discussed under this heading.

Each student's eyes are tested for color blindness early in the course, in order that he may be given an opportunity to change his course if his eyes should prove defective enough to interfere with his work as a textile colorist.

A dark room has been provided where various experiments in color work and color matching may be performed.

Dye Testing. — This subject includes the testing of several dyestuffs of each class, subjecting them to the common color-destroying agencies; the determining of their characteristic properties, and their action towards the different fibres; also the determining of the actual money value and coloring power of dyestuffs in terms of a known standard.

Each student is required to make a record of each color tested upon an especially prepared card, which furnishes a permanent record of all dyestuffs, their dyeing properties, fastness to light and weather, washing, soaping, fulling, perspiration, bleaching, steaming, ironing, rubbing, acids and alkalies.

Union Dyeing. — A study of the principles involved in the dyeing of cotton and wool, cotton and silk, and silk and wool union materials in the production of solid and two-color effects.

Textile Printing. — A thorough study of the whole subject of textile printing, each student being required to produce individually no less than twenty different

prints, including the following styles: pigment style, direct printing style, steam style with tannin mordant, steam style with metallic mordant, madder or dyed style, the ingrain or developed azo style, discharge dye style, discharge mordanted style, resist style, indigo printing, aniline black printing.

The different parts of the calico printing machine are thoroughly studied; also the precautions which must be considered in its use, and the arrangement of the dyeing apparatus which must accompany such a machine.

Special attention is paid to the methods of mixing and preparing the various color printing pastes that are used in the above work upon a manufacturing scale as well as experimentally in the laboratory.

Cotton Finishing. — A study of the various processes of finishing cotton cloth and the different materials used therein. The work involves the discussion of the various objects of cotton finishing and such operations as pasting, damping, calendering, stretching, stiffening, mercerizing, beetling and filling, and the various machines used for carrying out these processes.

Mill Visits. — During the third and fourth years visits are made to some of the large dyehouses, bleacheries and printworks in the vicinity. [Course IV.]

Organic Chemistry Laboratory — C-15. Preparation: C-4, C-5, C-6, C-9.

This course, while including practice in the usual methods of organic analysis, and giving excellent training in the principles and manipulations of general organic synthesis, is especially devoted to the synthetic dyestuffs. The student not only prepares many of the representative dyestuffs, but, what is far more important, he carries out all the operations, beginning with coal tar itself. Thus, instead of merely coupling two or more of the foreign imported intermediate products to make a dyestuff, he starts with the basic substances obtained from the coal tar, and makes his own intermediate products. As far as is possible the student will be made acquainted with the problems which might arise in a dyestuff factory, and an excellent opportunity is presented for original work. [Course IV.]

Engineering Chemistry — C-16. Preparation: C-4, C-5, C-6.

A series of lectures is given upon the general subject of Engineering Chemistry, which include particularly the consideration of fuels, oils and water from the chemical engineer's standpoint. The elements of chemical engineering are also considered to such an extent as time will permit. [Course IV.]

Industrial Analysis — C-17. Preparation: C-6.

In conjunction with the lectures in engineering chemistry there is required a specified amount of laboratory work in the Industrial Analysis Laboratory, which has been recently thoroughly equipped with the latest and best apparatus for fuel and oil analysis. [Course IV.]

Microscopy and Photomicrography — C-18. Preparation: B-11, C-4, C-5, C-6, C-9.

The value of the microscope in the detection and examination of the various fibers cannot be overestimated, and often facts may be discovered, and conclusions drawn, which could be arrived at in no other way.

The students in this course are given as much work with the microscope as time will permit. They receive instruction in the use of the high-grade microscopes, and not only have practice in the examination and detection of the fibers, but are required to become proficient in the preparation of permanent slides.

Opportunity is also given for students to take photomicrographs of fibers and the various slides which they may prepare. A special dark room has been provided for this purpose. [Course IV.]

Advanced Dyeing Conference — C-19. Preparation: C-9.

During the latter part of his course each student will be required to write, for presentation before the other members of his class, a paper upon some assigned subject of general interest. After presentation the subject will be open to discussion and question.

The object of this conference is twofold. First, to give the student experience and

practice in systematically looking up an assigned subject, and presenting it before others; and secondly, to bring before the class a greater variety of subjects with more detail than could be covered by the general lectures of the course. [Course IV.]

Advanced Organic Chemistry (Dyestuffs) — C-20. Preparation: C-15.

This course consists of an advanced study of the coal-tar coloring matters, their chemistry, relations of their composition to their coloring power, and the chemistry of their preparation. [Course IV.]

Technical German — C-21. Preparation: E-3, C-4, C-5, C-9.

This course consists of the reading of German technical literature, with the object of familiarizing the student with the current German publications in textile chemistry and coloring. [Course IV.]

Thesis — C-22.

Before graduation the student must present a thesis which shall consist of a report of some original investigation or research that he has conducted while at the school.

A relatively large number of hours are specially set aside for this work, and students are encouraged to select some object for their investigation which shall be of practical as well as theoretical interest. [Course IV.]

TEXTILE DESIGN AND WEAVING DEPARTMENT — D.

Textile Design — D-1.

During the first year instruction is given in the subject of classification of fabrics, use of point or design paper, plain fabrics, intersection, twills and their derivation, sateen, basket and rib weaves, checks and stripes, fancy weaves, including figured and colored effects; producing chain and draw from design, and *vice versa*; extending and extracting weaves. [First term, all courses.] [Second term, Courses I, II, III, VI.]

Decorative Art — D-1.

The instruction in this subject is given in connection with Textile Design, and is conducted entirely by class work. During the first term freehand drawing is taught by means of plates and models, and practice in coloring is given in conjunction with this work.

Practice in lettering, spacing and general arrangement of designs and sketches is given. The engineering alphabet is used in all work.

During the second term instruction is given in drawing, sketching, coloring and designing, with reference to their application in textiles. Good examples of applied design in textiles, as well as in other branches, are used as a basis for modified designs selected and composed by the student. This stimulates originality as well as teaches the student to appreciate good designs and color.

Cloth Analysis — D-1.

In the first year this subject takes up in a systematic manner the analysis of samples illustrating the various cloth constructions for the purpose of determining the design of the weave and the amount and kind of yarns used, and forms the basis of calculation in the cost of reproducing any style of goods. The various topics discussed are reeds and setts; relation and determination of counts of cotton, woolen, worsted, silk, and yarns made from the great variety of vegetable fibers; grading of yarns, folded, ply, novelty and fancy yarns; application of the metric system to yarn calculation; problems involving take-up, average counts, determination of counts of yarn, and weight of yarn required to produce a given fabric. [First year, all courses.]

Textile Design — D-2. For Cotton Goods — Preparation: D-1.

During the second year consideration is given to fancy and reverse twills, diaper work, damasks, skip weaves, sateen fabrics with plain ground, backed fabrics, and multiple ply fabrics. Students are required to make original designs and put the same into the loom. Special attention is given to the consideration of color effects.

Weave Room.

The analysis of these fabrics forms a part of the course in design. This also includes the necessary calculations required to reproduce the fabric or to construct fabrics of similar character. [Courses I, III, VI.]

Textile Design — D-3. For Woolen and Worsted Goods — Preparation: D-1.

During the second year the instruction given includes warp and filling backed cloth, figured effects produced by extra warp and filling, double cloths, multiple ply fabrics, cotton warps, blankets, bath robes, crepes, filling reversible, Bedford cords, imitation furs, crepons, matelasse and imitations, double plain, ingrains, velvets, corduroys, overcoatings, trouserings.

The analysis of these fabrics, together with the consideration of the shrinkages and dead loss in all fabrics, theory of diameter of yarns, and costs of mixer blends, is a part of this course. [Courses II, III, VI.]

Decorative Art — D-4. Preparation: D-1.

The work of the second year is similar to that of the previous year, but is more advanced and specific. More original work is required as well as copying and composition work. [Course III.]

Textile Design — D-6. Preparation: D-2 or D-3.

The advanced work takes up the more complicated weaves adapted to harness work, and leads into leno and Jacquard designs. The following is a brief list of the subject heads, which will give some idea of the course: double plain cloths, ingrains, tricots, chinchilla, tapestry, blankets, upholsteries, spot weaves, pile or plush, crepon, matelasse and its imitations, pique, Marseilles, quilting, and miscellaneous designs for Jacquard, leno, fustian, tissue fabrics and lappets.

The same plan is pursued during this year as in the second year, — that of requiring the student to make original designs and to weave the same. [Courses I, II, III, VI.]

Cloth Construction — D-7. Preparation: D-2 or D-3.

The work includes the application of the different weaves and their combinations in the productions of fancy designs, both modified and original; the calculation involved in the reproduction of standard fabrics changed to meet varying conditions of weight, stock, counts of yarn and value; and the discussion of the breaking strength of fabrics and relationship of the construction of the fabric to breaking strength.

Instruction in this subject, which is given by classroom work, is intended to bring together the principles considered under the subject of design, cloth construction, weaving and yarn making of previous years, and to show the bearing each has in the successful construction of a fabric. [Courses I, II, III, VI.]

Decorative Art — D-8. Preparation: D-4.

Original designs and sketches for particular grades of goods and the study of color effects form the important part of the third-year course. It should be understood that work in decorative art is carried on in conjunction with textile construction and weaving, particularly on the Jacquard loom. Designs of merit are carefully developed in detail and woven into cloth. [Course III.]

Decorative Art for Special Students.

This course is planned to give a student a working knowledge and appreciation of design. The first and second years are devoted to a general study of design, color, perspective, lettering and rendering. Drawings are made in the historic styles for all materials, — wood, gold, silver, copper, brass, leather, fabrics, wall papers and glass.

In the third year students should specialize and devote their attention to the material in which they expect to work.

Power Weaving — D-9. Preparation: D-1.

In connection with the work in Textile Design and Cloth Analysis practical work is carried on upon the power looms. This includes the preparation of warps, beaming, dressing, sizing, drawing-in and making of chains, the cutting and lacing of cards, spooling and quilling and the machinery for the same. A study is made of warpers and sizing machines, both for cotton and woolen. Lectures are given to correspond with the progress of the student in the Power Weaving Laboratory covering the following subjects: loom adjustments, chain building, shuttle changing looms, dobby looms, single and double acting dobbies, handkerchief motions, leno weaving, center selvedge motions, filling changing looms, oscillating reeds, lappet motions, various shaker motions, towel and other pile cloth weaving, Jacquard looms, single and double lift leno Jacquards, Jacquards of special design, tying up Jacquard harness. [Courses I, II, III, VI.]

Power Weaving — D-10. Preparation: D-9, D-2, or D-3.

Instruction is given in weaving on fancy woolen and worsted looms, single and double acting dobbies, leno weaving, various shaker motions, lappet loom weaving, double and single lift Jacquard looms, tying up Jacquard harness, leno Jacquard, harness and box chain building; warp preparation for woolen and worsted and cotton; formulas for making up different kinds of sizing. Lectures are given to correspond with the same. [Courses I, II, III, VI.]

LANGUAGE AND HISTORY DEPARTMENT — E.

English — E-1. Preparation: Admission Requirements.

A technically trained man should be able to express himself clearly, forcibly and fluently, as inability to do so will be a serious handicap to him in after life. The object of the English course is to develop the student's power of expression by a thorough study of the principles of advanced rhetoric and composition, and by constant writing of themes illustrative of the four forms of discourse, viz., description, narration, exposition and argumentation. In addition to the study of rhetoric and composition and the writing of themes, several classics such as are not read in the preparatory schools are studied and discussed. [All courses.]

Elementary German — E-2. Preparation: Admission Requirements.

This course is for first-year students. The work is elementary in character, and much time is devoted to the study of the rudiments of German grammar with practice in composition. During the latter part of the year considerable attention is given to the reading of ordinary German prose, which serves as an additional preparation to the student for the later reading of works along scientific and industrial lines.

Advanced German — E-3. Preparation: E-2.

For students who are pursuing a degree course the elementary course of the first year is continued throughout the second year. The work consists of the study of some of the more advanced principles of grammar, and especially of the reading of scientific German dealing with a variety of subjects, and the translation of commercial German. [Courses IV, VI.]

Elementary French — E-4. Preparation: Entrance Requirements.

This course is for first-year students. The work is elementary in character, and much time is devoted to the study of grammar and composition. Facility in translation is acquired by a considerable amount of reading from general or scientific sources.

Advanced French — E-5. Preparation: E-4.

For students who are pursuing a degree course the elementary course of the first year is continued throughout the second year, and the work is devoted almost entirely to the translation of scientific French. [Courses IV, VI.]

Industrial History — E-6. Preparation: Admission Requirements.

The economic history of a nation is not less interesting or dramatic than its political history, while it is absolutely essential to a thorough understanding of modern business conditions. The object of this course, which is intended for second-year students, is to trace the development of the three leading industrial nations of the world, viz., the United States, England and Germany, from simple, isolated agricultural communities to the complex industrial and commercial society of to-day. The course consists of weekly lectures supplemented by textbook reading. Among the topics treated are natural resources; colonization, territorial expansion; manufactures; agriculture; finance; commerce; transportation; revenue tariffs; monopolies; governmental regulation; organization of labor; industrial legislation; immigration, conservation; contemporary problems. During the year each student will be required to write two or more theses on subjects connected with industrial history, in order that he may have practice in research work and also may continue his training in English. [All courses.]

Economics — E-7. Preparation: E-1, E-6.

This course consists of lectures supplemented by recitations based upon both the lectures and a textbook. The character of the course is descriptive rather than theoretical, and the aim is to acquaint the student with the accepted principles of economics and some of their applications to industrial conditions.

Among the topics discussed are the nature and scope of economics; the evolution of economic society; the three factors of production, land, labor and capital; the four elements in distribution, rent, wages, interest and profits; business organization; value and price; monopoly; money, credit and banking; international trade; protection and free trade; transportation; insurance; economic activities of municipalities; and public finance. In short, the course deals with the fundamental principles that underlie a wide range of activities. [Courses IV, VI.]

COTTON DEPARTMENT — F.

Yarn Manufacturing — F-1. Preparation: B-1, B-4, B-7.

Instruction is given by means of lecture and laboratory work. The outline of the course is as follows: —

Fiber. — Before taking up the details of the operation of manipulating the fiber into yarn, a careful study is made of the characteristics and classification, both botanically and commercially, of the many varieties of the cotton fiber. Methods employed in cultivating, marketing, grading and stapling are considered, and under these heads a detailed study is made of the types of gin employed.

Opening and Picking. — Instruction in the preliminary operation of opening and picking covers the mechanical construction of the machines, their parts and adjustments, as fully as the manufacturing results accomplished by the machines. This includes such construction details as evener, lap measuring and safety stop motion, grids, cleaning trunks, beaters, etc.; also operation details which involve the adjustment of waste, drafts and character of laps.

Carding. — The process of carding is considered one of the most important, and proper time is devoted to the construction and operation of cards that the student may be familiar with the various parts of the card and the function and design of each. The construction and application of card clothing, as well as the methods of grinding, form a part of the work.

Drawing. — Under this head is taken up the theory of doublings and their effect upon the quality of roving and yarn. Like previous and subsequent processes the machine construction forms an important part of the work. Proper stress is paid to such subjects as stop motions, drawing rolls and their covering, cleaners and evener motions.

Roving Processes. — Under this head are studied the various machines known as the slubber, intermediate, fine and jack fly frames. The relative motion of the various parts of these machines is so complex that a good opportunity is here presented to fix in the student's mind the application of certain mechanical principles that are used in other departments and upon other machines in the manu-

facture of textile material. With each process of yarn manufacture are explained the systems of sizing and numbering, and under this head are taken up both the metric and English systems.

Yarn Manufacturing — F-2. Preparation: F-1.

Ring Spinning and Twisting. — The consideration of spinning yarn by the ring frame method involves a knowledge of the uses to which the yarn is to be put, subsequent methods of handling that proper roving may be selected, suitable amounts of draft and twist provided, correct size of rings and travelers selected, building motions suitably adjusted, etc. The operation of twisting yarns is so closely related to spinning by the ring method that it is studied at the same time. This opens an almost limitless field of novelty yarn manufacture, and offers a very good opportunity to derive new types of yarn or new mechanism to produce the effects. Yarn defects are studied with reference to the cause and remedy.

Mule Spinning. — This method of spinning is very different from that of the ring frame, and the mechanical details are more complicated. The student is furnished with new means of producing yarns, and can compare the relative advantage of each method. A thorough understanding of mule spinning is perhaps more a study of mechanical motions and their functions. This results almost invariably in assisting the student to understand previous processes and machines better because of his work on the mule. It is the object to make clear to the student's mind the principles underlying the construction and operation of the parts that control the drawing, twisting, backing off, winding, together with such special motions and devices as are used upon the modern mule.

Combing. — This process is explained by lecture work and by operation and assembling of the various types of combs in service in the laboratory. The object of combing is fully considered, and the different means employed on the many types of combers on the market is studied. This includes such types as the Heilman, New Whitin and Nasmith combers.

Organization. — Following the detailed study of the individual processes it is necessary to consider the relation of each to the other, the programs, balance of production, cost of machinery for various counts, quantities and styles of yarns. Under this heading are also studied such subjects as depreciation of machinery, cost systems, economics, arrangement of machinery, power demands, etc. [Courses I, III, VI.]

Knitting — F-3. Preparation: F-1-2 or G-1.

This course consists of lecture work on the theory and practice of knitting and laboratory work where the theory is illustrated with practical construction of different garments.

Flat Machine Knitting. — The lecture course includes a study of the parts of flat machines with particular emphasis on the different cam systems and the various stitches produced by them. A study of warp knitting is made with special emphasis on the difference between it and ordinary knitting. This is followed by laboratory practice on the Raschel machine illustrating the many possibilities in this field. Some time is given to a study of layouts for garments made on these machines and then in the laboratory various articles are manufactured, such as scarfs, caps, shaker and light sweaters, mittens and ties.

Hosiery Knitting. — These lectures treat of the mechanisms of the various ribbers automatic hosiery machines and loopers, pointing out the particular types of garments made with various arrangements and the necessary steps in producing and putting up the articles.

The laboratory practice follows the lecture work illustrating with the machine and material what is actually done in making various kinds of hosiery.

Underwear Knitting. — Lecture work on this branch of the industry involves the machines used for underwear fabric and their particular mechanisms. At this point the manufacture of knitted materials for dress goods, suitings and coatings is brought in and a discussion of seams and sewing machines. The operations necessary in making underwear are illustrated and the matters of size and design brought in.

The practice includes work on the underwear fabric machines and the sewing machines.

Cotton Yarn Department.

In addition to this special work the lectures include the study of the characteristics and preparation of knitting yarns, the analysis and design of knitted fabrics, with periods of laboratory time taken to perform actual experiments along these lines.

WOOL DEPARTMENT — G.

Yarn Manufacturing — G-1. Preparation: B-1, B-4, B-7.

Raw Materials. — A study of raw materials which enter into the manufacture of woolen or worsted yarns, or are made into yarns by processes similar to those employed in the manufacture of woolen and worsted yarns, would include silk, mohair, alpaca, vicuna, cashmere, camel's hair, cotton, flax, hemp, jute and ramie. In connection with these are considered shoddy, noils, mungo and extracts.

Wool Sorting. — Familiarity with the various grades and kinds of wool is obtained by lecture and by actual sorting of fleece wool under the direction of an experienced wool sorter. The various characteristics and properties are explained, as are also trade terms, such as picklock XXX, XX, ½-blood, ⅜-blood, ¼-blood, delaine, braid, etc. Some skill is acquired in the estimation of shrinkage and in judging the spinning qualities.

Wool Scouring. — The object of scouring and the methods employed are explained, and this involves the consideration of the soaps and chemicals used in washing; also the waste products and their utilization. Actual work is done in scouring a commercial quantity of wool by machines that are made similar in operation to regular commercial machines. A study is made of the effect of the hardness of water upon soap; also tests are made to show this effect. At the same time the use of driers, their operation and regulation, is taken up, and the methods of carbonizing wool, noils, burr waste, rags, etc., are studied and practiced.

Burr Picking, Mixing and Oiling. — In these processes, preliminary to carding, the students have an opportunity of mixing various colors of wools to produce different effects, and the influence of varying percentages of a given color in a mixture can be seen. Each student is required to make at least twenty sample mixes combining different colors and grades of stock, and to felt and mount the same. Under the subject of oils and emulsions are taken up the characteristics of various oils and the means employed to test these. The use of mixing and burr pickers is made clear.

Carding. — The different systems of carding wool, depending upon whether it is to be made into woolen or worsted yarn, are fully explained, as is also the construction, setting and operation of the cards. A part of the work is the reclothing and grinding of the cylinders, strippers, workers, etc. The carding of suitable and commercial quantities of wool, and the further manufacture of it into yarn, serves to fix the principles of carding in the mind of the student, as well as to give him some skill in handling machinery. At the completion of this part of the work he is required to prepare and hand in a full description of the process of carding, including working drawings, sketches, etc., to fully explain the machines and the methods.

Woolen Mule. — The student studies thoroughly the operation of the mule as a whole, and acquaints himself with the various principal mechanisms, as, for example, the backing off and winding motions, the quadrant, builder-rail, faller regulation, etc. He is required to run the mule and later hand in a thesis describing in full the machine, its parts and their operation.

Yarn Manufacturing — G-2. Preparation: G-1.

Top Making and Combing. — This branch takes up, besides the carding of the wool on a worsted card, the preparing processes; also gilling of the stock before and after combing. The construction of the gill boxes and combs is studied by lectures, and by dismantling and assembling these machines in the laboratories. Later, quantities of stock are made into top and then into yarn.

The Noble and Lister combs are studied, and the various calculations to determine draft, noiling, productions, etc., are made.

Drawing and Spinning. — The equipment in the laboratory offers opportunity to make worsted yarn by either the Bradford or open drawing system or by the French system. The process includes the various machines in the successive

steps of making Bradford spun yarn, and the functions of the different machines are studied. In the latter, or French system, the stock is run through the drawing machines, and the roving spun into yarn on the French mule. The same method of studying the mechanism and operations of these machines is followed as in the case of previous methods of instruction. The student by pursuing this course can compare the different methods of yarn manufacture and note the results of each.

With the instruction on the Bradford system is given work on the twisters and the effects that may be produced.

Organization. — At the end of the course the layout of a properly balanced yarn mill is studied, and at the same time the cost of the machinery, depreciation, labor costs and machinery arrangements. [Courses II, III, VI.]

Textile Testing — G-3. Preparation: F-2 or G-2, D-6, D-7, D-9.

The object of this course is to familiarize the student with present-day methods of determining the physical properties of textile fibers, yarns and fabrics. The application of physical laws and methods of measurements, as studied in the Course of Physics, is used in the study of physical characteristics of textile material. The work is given to students in advanced courses, and consists of lecture and laboratory work. Reports are prepared from each experiment, giving the object of the experiment, method of procedure, observation and conclusions, in order that the student may acquire practice and understand the interpretation of data. A special testing laboratory is provided, and a considerable number of the best standard fiber, yarn and fabric testing instruments of foreign and American make have been installed and are used for instruction in the testing of textile materials. The laboratory is equipped with means of making and keeping the humidity constant, so that tests can be made under uniform or standard conditions of humidity and temperature. [All courses.]

FINISHING DEPARTMENT — H.

Woolen and Worsted Finishing — H-1. Preparation: B-4, C-1, D-1, D-9, G-2.

The outline of this course, which is given by means of lecture and laboratory work, is as follows: —

Burling and Mending. — Under this head is taken up for consideration the examination of flannel as it comes from the loom; the construction, use and location of the perch; the methods used in marking defects, measuring, weighing and numbering of cloths; also the methods of inspection for fancies, single cloths and double cloths. The object of burling, mending and the types of tables employed, the method of removing knots, runners, etc., the object of back shearing and the use of burling irons, the replacing of missing threads and the importance of sewing as a part of the finishing process, are all considered in detail. The removal of oil and tar spots as well as stains of various kinds is studied.

Fulling. — This branch covers a study of the conditions of the flannel as it comes from the loom, and the influence of oil, etc., upon the procedure. Considerable time is devoted to the various methods of producing a felt, the early types of stocks, hammer falling and crank stocks, and their modifications and development into the present type of rotary fulling mills of both the single and double variety. The details of construction in all machines are carefully taken up and include the design and composition of the main rolls, methods of covering, regulation and means of adjusting the pressure of traps and rolls, consideration of the shoes, the use and regulation of the various types of stop motion, the different types of stretchers, guide rolls and throat plates.

The theory of felt is taken up and the influence of pressure, moisture, heat, alkali and acid is considered, as well as the hydroscopic and felting properties of different wool fibers. The preparation of the flannel for the mill and the usual methods of determining shrinkages, as well as the various methods of soaping, are given careful attention. The preparation of various fulling soaps and the value of each for the production of various degrees of felt, as well as the determination of the proper amount of alkali for various goods, are carefully studied and

Finishing Department.

demonstrated. The manipulation of the various kinds of goods in the mill, viz., all wool, shoddies and mixed goods, is studied in classroom and by operation in the mill.

The change in weight and strength for each operation is carefully considered, as is also the value of the flocks made in each. A study of the various methods of flocking, such as dry and wet, is considered in both class and machine rooms. In each operation the defects likely to materialize are studied, as well as the cause thereof, and various methods of modifying or lessening them.

Washing and Speck Dyeing. — This branch considers the scouring, rinsing and washing of goods both before and after the fulling process; the various types of washers; and the details of construction, such as suds box, rolls, etc. The theory of scouring, uses of Fuller's earth, salt solutions and scours on the different kinds of goods are made clear by practical work in the machine room, where the effects due to improper scouring, such as stains, cloudy effects, wrinkles and unclean goods, are demonstrated. The discussion of the necessity of speck dyeing follows naturally from the study of these matters, and includes methods of preparation, materials used, application and tests required.

Carbonizing. — This is an important branch of finishing, and includes a study of the various carbonizing agents, methods of application, strength of solutions, and neutralizing, as well as the machines used. Stains and imperfections resulting from carbonizing are also considered. The drying and tentering machines and extractors employed are taken up at this point.

Gigging, Napping and Steaming. — The construction in detail of the various types of gigs, nappers, steamers, wet gigs, rolling, stretching, crabbing and singeing machines is discussed, and their actions upon the cloth and the results obtained are explained.

Various methods of obtaining luster and the production of permanent finish are considered in connection with steaming and sponging.

Brushing, Shearing and Pressing. — This includes, as do the other branches, a careful treatment of the machine employed, the preparation of the cloth for each process, the action of each machine in producing its part of the resultant effect. In manipulation of the shear consideration is given to its setting, grinding and adjustment. With the brushing machine the effect of steaming and moisture upon the luster and feel of the goods is shown. A study of the action of the presses, both plate and rotary, involves consideration of pressure, steaming, etc. Special processes to obtain particular effects are taken up, and the part played by each machine is explained. The details involved in handling cloth on a commercial scale, as, for example, measuring, weighing, ticketing, numbering and rolling, are also explained. The necessary calculation and the methods of finishing all grades of goods are considered from time to time during the year. [Courses II, III, IV, VI.]

Cotton Finishing — H-2. Preparation: B-4, C-1, D-1, D-9, F-2.

The outline of the course in the finishing of cotton fabrics is as follows: —

Cloth Room. — Instruction of the various goods and the object thereof; construction of the various types of inspecting and trimming machines.

Shearing. — The object. A consideration of the various types of shears for treating one or both sides at the same time; also the use of the usual cleaning devices, such as emery, sand and card rolls, beaters and brushes; grinding and the adjustment of the various parts.

The use of brushing and cleaning machines, rolling devices and calender attachments for gray goods.

Singeing. — Developing and object of singeing; the construction of singers of all types, and for various purposes; the use of cooling tanks, steaming devices, rolling and brushing attachments.

Regulation of the flame for various goods, and adjustment of the parts; gas and air pressure, water-cooled rolls; the effect of moisture on the cost of singeing; the use of dry cans in connection with singeing; electric singeing.

Washing. — Open width and string washers, their construction and operation; soaps, temperature, squeeze rolls; washing of various goods and the object thereof; stains.

Napping. — The object of napping and the usual method of treating goods; various types of nappers, single and double acting; felting nappers; construction, grinding and adjustment of various types.

Water Mangles. — Their object and the construction of various types; various rolls, iron, husk, etc.; scutchers, their object and constructions.

Starch Mangles. — The object and construction of all types of starch mangles for pure starch and filled goods; various types of rolls, brass, rubber, wood; action of doctor blades, etc.; regulation and object of pressure.

Methods of starching and finishing all standard goods, also a consideration of the various substances used, such as starch, softener and fillers; the preparation of starch and various methods of application.

Dryers and Stretchers. — Both horizontal and vertical, tenter frames, clips; the swing motion and the finishes thus produced; construction; spraying machines, belt stretchers, button breakers; their object and construction.

Calenders. — The object and construction of all types, including the regulation of pressure and nips for the production of various finishes; various types of rolls and their uses, — steel, husk and paper; the use of hot and cold rolls; chasing, friction, embossing and Schriner calenders, and the various finishes produced by each; production of watered effects; beetling machines.

Making up room, — yarding, inspecting; different types of folds; pressing, papering, marking. [Courses I, III, VI.]

PHYSICAL EDUCATION — I.

All members of the freshman class are required to take a course in physical training conducted in the gymnasium under the direction of an instructor in physical education. Two periods per week for the entire first year are devoted to this work.

The object is to give general instruction in the care and strengthening of the body, and to so guide the students that they may continue to give proper thought to their physical training that their mental development may have its greatest effect.

Proper gymnasium clothing is required and all students must take a shower bath following each exercise.

BUILDINGS AND GROUNDS.

The site is a commanding one, consisting of about 15 acres at a high elevation on the west bank of the Merrimack River. It extends to and overlooks the rapids of Pawtucket Falls, which was the first water power in America to be used on an extensive scale to operate power looms. It was contributed by Frederick Fanning Ayer, Esq., of New York City, and the Proprietors of the Locks and Canals on the Merrimack River.

Southwick Hall, the main building, fronting on Moody Street, was contributed by the Commonwealth of Massachusetts and Frederick Fanning Ayer, Esq., and is a memorial to Royal Southwick, a leading textile manufacturer, a public man of earlier days, and a maternal ancestor of Mr. Ayer. It includes a central mass 90 by 90 feet, having three stories and two wings 80 by 85 feet each with two stories and well-lighted basements. The building is pierced in the center by an arched way from which access is had to the wings and to the central courtyard. The northern wing is occupied by the General Offices, Engineering and Finishing departments, and Library, while the southern wing is entirely occupied by the Chemistry and Dyeing departments.

Kitson Hall, dedicated to the memory of Richard Kitson, was contributed by Charlotte P. Kitson and Emma K. Stott, his daughters; the Kitson Machine Company of Lowell, founded by Mr. Kitson, was also a generous contributor. This hall makes a right angle with Southwick Hall, is 70 by 183 feet, and has two stories and a basement. The first floor is occupied by the Cotton Yarn and Knitting departments, while the basement contains the Mechanical and Electrical Engineering laboratories and the Machine Shop.

The Falmouth Street Building forms the third side of the quadrangle, and consists of three portions, one 60 by 75 feet, three stories, one 75 by 130 feet, three

stories, and the head house 70 by 80 feet, three stories and basement. The building is occupied by the picker section of the Cotton Yarn Department, the Design and Power Weaving Department and by the Woolen and Worsted Yarn Department, and contains on the lower floors an equipment for the manufacture of wool yarn from the fleece to the finished yarn. The upper floors are occupied by a great variety of plain, dobby and Jacquard looms, and in a section of the building are the students' lockers and recreation rooms.

Colonial Avenue Building was erected in the summer of 1910 from plans prepared by the Engineering Department, which also had in charge the work of construction. The building completes the fourth side of the quadrangle, and in outward appearance corresponds to the architectural features of the other school buildings. It is a single-story building, and has the dimensions of 195 by 60 feet. Its interior is faced with cement brick made at the school during the progress of the work. These serve to give light reflecting walls which are advantageous for the work of the Wool Manufacturing, Cotton Finishing and Chemistry and Dyeing departments that occupy this building. The funds for this building were provided by the State of Massachusetts.

The buildings are all faced on the exterior with light brick with granite and Indiana limestone trimmings. They are of modern mill construction adapted to educational uses. The floor space of the several departments is as follows: —

Cotton Yarns and Knitting, 16,200 square feet.
Woolen and Worsted Yarns, 28,160 square feet.
Textile Design and Decorative Art, 16,806 square feet.
General Chemistry and Dyeing Laboratories, 28,400 square feet.
Finishing Cotton, Woolen and Worsted, 10,606 square feet.
Power Weaving, 15,360 square feet.
Textile Engineering, 24,297 square feet.
Power plant, 10,047 square feet.
Assembly and physical culture halls, 10,800 square feet.
Entrances, corridors, stairways, etc., 14,487 square feet.

Additional floor space is devoted to Administration Offices, Library, classrooms, storerooms, etc.

CAMPUS.

Through the generosity of Mr. Frederick Fanning Ayer the school has been provided with a campus and athletic field of about 3 acres. This has been carefully graded and laid out for baseball, football and track athletics.

To enclose this field the Alumni Class Fence has been partly built. It is made of forged iron sections supported between brick columns. Each section is contributed by a class, so that in the course of a few years this fence will entirely enclose the field.

On the upper floor of the Falmouth Street Building there has been provided a recreation room for the use of the students at such times as their attendance is not required in classes.

In the basement of this building there are rooms for the use of the athletic teams. Connected to these are showers and dressing rooms.

The upper hall of Southwick Hall has been equipped with gymnastic apparatus. Chest weights, wooden dumb-bells, Indian clubs, a set of traveling rings, a vaulting horse, parallel bars, and a punching bag.

In order to be sure that no student having any dangerous physical weakness takes part in any athletic contest, all candidates for the various athletic teams are obliged to pass a satisfactory physical examination.

EQUIPMENT.

The equipment of machinery, inventoried at $291,519.40, is most varied for textile educational purposes, and is being constantly augmented. The builders of the various machines installed keep in close touch with the school, adding to the machines such improvements as are made from time to time, and each year some new machine will be added by a manufacturer who finds it to his advantage to be

represented here. This operates to the mutual advantage of student and manufacturer.

Cotton Yarns Department. — The opening and picking section of this department contains a 40-inch two beater breaker lapper with automatic feeder, a 40-inch single beater intermediate finisher lapper with Perham & Davis sectional plate evener, apron to double four laps, a 40-inch single beater finisher lapper with Perham & Davis sectional plate evener, apron to double four laps, and a Kirschner patent carding beater, a roving waste opener and a thread extractor, all of which have been installed by the Kitson plant of the Saco-Lowell Shops at Lowell.

There is also a 50-saw gin from the Daniel Pratt Gin Company of Prattville, Alabama, besides facilities for teaching the grading and classification of cotton.

The carding, combing and drawing section contains the following machinery from the Saco-Lowell Shops: — a top flat card, three revolving flat cards, two of which form a unit for waste carding, three railway heads and two drawing frames. One of these cards is equipped by the Chapman Electric Neutralizer Co., Portland, Maine with an electric neutralizer to prevent troubles from static electricity.

The Whitin Machine Works, Whitinsville, Mass. have installed a 40-inch revolving flat card, a sliver lapper, one four-head and a six-head ribbon lapper besides a two-head, a six-head and an eight-head comber.

There is also a two-head comber with a model comber head made by John Hetherington & Sons, Ltd., Manchester, England.

The roving, spinning, and twisting section has the following machinery installed by the Saco-Lowell Shops of Lowell: — two slubbers one of which is for waste spinning, an intermediate, a fine and a Jack frame also five ring spinning frames, a spinning mule, spooler and a wet and dry twister.

The Fales & Jenks, Pawtucket, R. I. and the Draper Corporation of Hopedale, Mass. have each provided a wet and dry twister; the Whitin Machine Works, three spinning frames, the Woonsocket Machine and Press Company, Woonsocket, R. I. an intermediate fly frame, and the Asa Lees Company, Oldham, England through their agents, Wm. Firth Company, a fine spinning mule.

Knitting Section. — The winders for this section include a six-spindle Universal winder for cones and tubes and a Payne bobbin winder. The hosiery machines include two Acme full automatic, one arranged for 160 needles and the other for 200 needles; also a Mayo Model C full automatic arranged for 220 needles. Scott and Williams have placed in this section three of their machines, two arranged for 220 needles and one arranged for 200 needles — Model B–5. There are three Banner machines, two of which are arranged for 220 needles each and one which is full automatic has been arranged for 200 needles. There is one Brinton full automatic arranged for 176 needles and one Branson hand machine arranged for 80 needles.

The machines in the following group are equipped with special attachments for producing lace front work, high splicing, double soling and striped work and consist of 5 ribbers, made by the Wildman Company, with cylinders varying from $3\frac{1}{2}''$–$5\frac{1}{4}''$ and arranged for needles varying in number for 160–240; 2 Brinton ribbers, one arranged for 176 needles and the other 200 needles; 1 Brinton tie machine, $1\frac{3}{4}$-inch cylinder, 100 needles.

The underwear machinery consists of one Crane spring needle machine, one Scott & Williams ribber, and one Wildman Ribber.

Under the group of flat machines there are three Lamb machines, one arranged for knitting gloves and one arranged for knitting sweaters. In addition to these there is also a Grosser sweater machine, a jacquard machine, and a link and link machine; a Dubied scarf machine; and a Raschel warp knitter.

For finishing work this section includes a Grosser 2-thread looper, one Hepworth looper, two Beattie loppers; 5 Union special sewing machines for overseaming, double stitch covering, seaming and welting and vest finishing; 6 Merrow sewing machines, including two shell stitch machines and three over-seaming and crocheting machines; 3 Singer machines.

Wool Yarns Department. — For instruction in wool sorting and grading the room is provided and equipped with benches, baskets, etc., as well as standard sample of all grades of wool which may be used for comparison and examination.

Wool Combing.

The scouring and carbonizing equipment installed by C. G. Sargent's Sons Corportion consists of one cone duster for grease wool; four scouring bowls arranged in tandem with necessary feeds and modern carrying properties; one single apron dryer, with automatic feeder; one cartonizing screw acid tank and duster, with crush rolls. In this same department the North Chelmsford Machine Company have supplied a rinse box; Schaum & Unlinger, one hydro-extractor; C. S. Dodge, one shoddy picker and one bagging stand.

Woolen. — In the woolen section there has been installed by the Atlas Manufacturing Company a Parkhurst Burr picker. The Davis and Furber Machine Company have installed a mixing picker equipped with improved mixing picker feed and Spencer oiler, both made by George S. Harwood & Son, Boston, Mass. There are three sets of woolen cards furnished by Davis and Furber Machine Company which are equipped with Bramwell feed furnished by George S. Harwood & Son. One of the sets has the first and second breaker cards coupled. All have apron condensers on the finishers. There is a sample mixing card furnished by the Torrance Manufacturing Company which offers an opportunity for carrying on experiments and mixing various kinds and colors of wool. There are two spinning mules, 120 spindles each, one furnished by the Davis & Furber Machine Company of North Andover and equipped with bobbin holders supplied by the American Bobbin Holder Company, West Medway, Mass. and the other furnished by Johnson & Bassett, Worcester, Mass. In addition to these two mules each company has supplied for the purpose of instruction a spinning mule head mounted on movable platform to facilitate class instruction. Besides these mules the Davis & Furber Machine Company have supplied a fancy yarn twister, 20 spindles; the Lindsay Hyde Company a modern skein winder. For Card grinding the B. S. Roy and Son Company of Worcester, Mass. have supplied one grinding frame and two traverse grinders; T. C. Entwistle Co., Lowell, Mass. one traverse grinder; W. H. Brown, Worcester, Mass. one complete set of carder's tools.

Worsted. — In the worsted section the Davis & Furber Machine Company have furnished one double-cylinder worsted card (4 licker-in) with Bramwell feed. On this card as well as one in the woolen section the Chapman Electric Neutralizer Company have supplied one of their patented electric neutralizers. This section also includes a double bowl, 5-cylinder backwasher, with gill box, Taylor-Wadworth & Co., Leeds, Eng., equipped with blueing motion, oiling motion, and Layland patent pressure motion; a weigh gill box and creel and one doubling balling head gill box (with double screws) made by the Saco-Lowell Shops of Lowell, Mass.; a worsted comb with baller punch made by Crompton & Knowles, Worcester, Mass.; two finishing gill boxes, one known as a can gill box and the other a balling head gill box, both made by Hall & Stell, Keighley, Eng.

For the manufacture of yarns under the Bradford System of Drawing, Spinning and Twisting the following machinery as made by Prince Smith & Son, Keighley, Eng. make up the equipment: one revolving creel for 12 balls, one 2-spindle drawing box, one 4-spindle first finisher, one 12-spindle dandy reducer, one 12-spindle cap spinner, one double head can gill box, one 2-spindle gill box, one 2-spindle flyer spinner, one 12-spindle ring spinner, one 12-spindle 2-fold cap twister, one 12-spindle 6-fold ring twister. In addition to this the Saco-Lowell Shops, Lowell, Mass. have installed the following machinery to carry on similar work: one 2-spindle drawing box, one 6-spindle second finisher, one 24-spindle dandy rover, one 6-spindle cone reducer, one 8-spindle cone rover, one 48-spindle cap spinner, 5-foot end, one 48-spindle cap spinner, 4-foot end, one 48-spindle Boyd ring twister. For conditioning yarn C. G. Sargent's Sons Corporation have supplied one of their conditioning machines. The Universal Winding Company have installed one of their 6-gang winders, equipped for cones or straight tubes.

The humidity in the laboratory of the woolen yarns and of the English system of worsted yarns is maintained by the American Moistening Company's system through their automatic control. In this laboratory are installed six humidifiers and four Comins' High Duty heads, which are supplied from an electric driven triplex power pump located in the power house. This same pumping equipment supplies the American Moistening Company's humidifiers operating in the Cotton Yarn Department.

For the manufacture of worsted yarns under the French System of Drawing and Spinning the machinery has been made by the Societe Alsacienne de Constructions Mechaniques, Mulhouse, France and the equipment consists of the following: Model P. L. B. comb with creel for 24 doublings, intersecting gill box (2 heads), gill box (2 heads), first drawing (2 heads), second drawing (2) heads, third drawing (2 heads), reducer (4 porcupines), slubber (8 porcupines), first intermediate (8 porcupines), second intermediate (8 porcupines), rover (8 porcupines), finisher (16 porcupines), self-acting worsted mule (150 spindles). Twelve turbo humidifier heads automatically controlled by a humidity regulator have been furnished by the G. M. Parks Company, Fitchburg, Mass. The compressed air for these heads is supplied by an Ingersoll-Rand 8 by 8 steam-driven air compressor.

For the purpose of determining the physical properties of fibers, yarns, and fabrics there has been installed a Textile Testing Laboratory where there are the necessary microscopes and micrometers, a skein testing machine, an electric conditioning oven made by the Emerson Apparatus Company of Boston; single yarn and fabric strength testing machines made by G. R. Smith & Co., Bradford, England; a strength testing machine, capacity, 500 kilograms, for testing twines and fabrics; a fiber testing machine for testing fibers and fine yarns with capacity, 1 gram to 1.5 kilograms; a yarn strength testing machine with capacity, 1,000 to 5,000 grams; and a yarn strength testing machine with capacity, 5 to 30 kilograms, all of which have been made by Louis Schopper, Leipzig, Germany. Besides these we have a standard yarn and fabric testing machine as made by Henry L. Scott & Company of Providence, R. I. and a Mullen Tester. For the automatic control of temperature and humidity there has been installed by the American Moistening Company of Boston one of their automatic humidity and temperature regulators.

Design and Power Weaving Department. — In the fabric analysis section there has been provided chemical balances made by Voland & Sons and Christian Becker, necessary twist testers, microscopes, reels, etc. as well as a Torsion calculation balance made by the Torsion Balance Company of New York.

In the warp preparation department there has been installed by the Saco-Lowell Shops one of their spoolers besides a warper and a slasher for preparing cotton warps; a beamer by T. C. Entwistle Company of Lowell, a 400-end improved Draper warper furnished by the Draper Corporation of Hopedale, Mass. The Whitin Machine Company, Whitinsville, Mass. have supplied a 180-spindle, long-chain quiller and the Johnson & Bassett Company, Worcester, Mass. a quiller of their make. The Universal Winder Company has supplied a winder for copy and bobbin winding and an 8-spindle doubler.

The woolen and worsted warp preparation department contains two 40-end Jack spoolers, two spool racks for 12 spools each, one pattern dry frame dresser, one pipe and cylinder dresser, one 60-inch reel, one 82-inch reel, and one double head beamer, all supplied by the Davis & Furber Machine Company of North Andover, Mass. For instruction in the manufacture of braids the New England Butt Company has installed one 24-line Hercules braider, one 12-line braider, one tubular braider, and one soutache braider. To illustrate the preparation of silk warps the Atwood Machine Company, Stonington, Conn., has furnished a winder, a ribbon quiller, a warper and beamer, Swiss style, also a double frame to be used with these machines.

The weaving department includes four looms supplied by the Draper Corporation of Hopedale, Mass. including one plain Northrup, one improved Northrup, one 8-harness corduroy, and a Northrup loom with dobby. The Saco-Lowell Shops, Lowell, Mass. have supplied nine plain looms, one 5-harness sateen, one 32-inch, 2 by 1 box; the Whitin Machine Works, Whitinsville, Mass., one side cam twill, one plain print cloth loom, equipped with Kip-Armstrong electric warp stop motion. Besides these the Mason Machine Works, Taunton, Mass. have supplied one plain print cloth loom; Kilburn & Lincoln one plain loom; Lewiston Machine Company one 4-harness, side cam; Crompton and Knowles Loom Works one Crompton jean loom. Four of these looms are equipped with Abbott cleavers, made by the Abbott Wire and Cast Steel Warp Cleaving Company, Lisbon Falls, Me.

The fancy loom section includes one bag loom, Lewiston Machine Company, Lewiston, Me., one Stafford Ideal loom, 16-harness, automatic shuttle-changing device, Stafford Loom Company, Readville, Mass., one 20-harness dobby loom, Whitin Machine Company, Whitinsville, Mass., and the following looms furnished by Crompton & Knowles Loom Works: — one Knowles gingham, 4 by 1 boxes, one Crompton gingham, 4 x 1 boxes, one Crompton towel, 2 by 1 boxes, one Crompton lappet in the 16-harness dobby, one Knowles fancy cotton, 20-harness dobby, 4 by 1 boxes, for fancy leno work, one Crompton fancy cotton, single cylinder, 20-harness dobby, one Knowles Gem, 20-harness, 4 by 4 boxes, one Crompton worsted, 24-harness, 4 by 4 boxes, one Crompton fancy, 6 by 1 double cylinder, 20-harness dobby, one heavy loom, 20-harness, 4 by 4 boxes, one Knowles blanket, 25-harness dobby, 4 by 4 boxes, one Crompton & Knowles blanket, 20-harness dobby, equipped with Draper automatic filling and changing device, one Knowles worsted, 32-harness, 4 by 4 boxes, three Knowles heavy woolen, 25-harness, 4 by 4 boxes, three Crompton & Knowles intermediate, 25-harness, 4 by 4 boxes.

The jacquard loom section includes one Stafford silk loom, 1,200-hook, Halton head; one 400-hook, single-lift, Schaum & Uhlinger Jacquard, mounted for 4-bank, narrow fabric loom; one Felix Tonnar German plush loom, with 400-hook Crompton & Knowles Jacquard head; one Skinner Brussels carpet loom, three-quarters wide, equipped with 1,280-hook Jacquard head presented by the Bigelow-Hartford Carpet Company, Clinton, Mass. The Crompton & Knowles Loom Works have furnished one Knowles fancy loom, single-lift Jacquard; one Knowles fancy loom, double-lift Jacquard; one Knowles fancy loom, Jacquard tied up for leno, one Knowles ingrain carpet loom, 4 by 4 boxes, one Knowles loom, 4 by 4 boxes, 54-inch, with 600-hook double-lift double-cylinder McMurdo Jacquard head. Tied up for damask napkin designs, one Crompton ingrain carpet loom, 4 by 4 boxes, one Crompton & Knowles 72-inch tapestry loom, with 2,600-hook Halton Jacquard head, one 840-hook double-lift, single-cylinder Jacquard on Crompton & Knowles 4-bank ribbon loom, one 800-hook, double-lift Knowles Gem silk brocade Jacquard machine, 4 by 4 boxes.

For the purpose of card cutting there has been furnished one Jacquard fine index card-cutting machine by John Royle & Sons, Paterson, N. J.; one Jacquard French index card-cutting machine by the same concern and one Jacquard French index card-cutting machine, presented by the Bigelow-Hartford Carpet Company, Lowell, Mass.

In the Hand Loom section there has been arranged about 45 hand looms of varying equipments for fancy and jacquard weaving.

Chemistry and Dyeing Department. — The Chemistry laboratories consist of one to give instruction in General Chemistry and Qualitative Analysis and provides facilities to take 120 students. The Quantitative Laboratory takes care of some 50 students and contains the necessary drying closet, steam bath, electrolytic table, with ample facilities to provide distilled water through the use of a Barnstead Water Still. The Balance Room which is adjacent to the laboratory has eleven analytical balances made by such concerns as Christian Becker, Eimer & Amend, and H. L. Becker's Sons & Co. The Organic Laboratory has facilities to take care of approximately 25 students having the necessary equipment required in the preparation of basic organic compounds and instruments used in the manufacture of dyes such as autoclaves, electric and gas combustion furnaces.

For the purpose of carrying on photographic and microscopic experiments and analyses the laboratory has been provided with equipment which includes besides the Bausch & Lomb microscopes, a polariscope made by Franz Schmidt & Haensch, Berlin, Germany, a Gaestner spectroscope, a Bausch & Lomb Model G photomicrographic apparatus equipped with D. D. S. microscope and all necessary apparatus, a Kodak projection printer. In the dark room there has been placed a piece of apparatus for determining the relative fading powers of various light sources. Besides the common gas and electric lamps there is installed a solar determinator, made by the Atlas Electric Company, Chicago, Ill.; also a 400-watt Nela Trutint and color matching unit made by Nela Specialties Division, Cleveland, Ohio.

The Chemical Museum has been provided with cases and representative dye stuffs all furnished by various dyestuff manufacturers of this country and abroad.

This offers an unparalleled opportunity for students to study and experiment with almost all of the representative dyes which are used in the textile industry.

The Experimental Dyeing Laboratory is equipped with individual benches, small dyeing apparatus, reels, balances, apparatus for dye testing, such as frames for exposing dyed material to light, and a complete collection of dyestuff samples and sample cards. There are also fifty-six steam coil experimental dyeing baths, a drying chamber and aging chamber, in addition to a Hurricane Dryer, Class D, made by the Philadelphia Drying Machinery Company, Pennsylvania. Adjacent to the Experimental Dyeing Laboratory there has been provided a well-lighted room for the storage of a great variety of dyestuffs. Steel shelving has been arranged so that the samples are easy of access. All samples are catalogued in a card file, thus facilitating their use. In this same room are provided a sink and cement table with balances.

The Experimental Printing Laboratory is equipped with a calico printing machine, made by Mather & Platt, Manchester, Eng., an iron jacketed steaming chamber from A. Edmeston & Son, Patricroft, Eng., and a set of steam jacketed copper kettles.

The Fuel and Oil Analysis Laboratory contains the following equipment for the analysis of coals and fuels: a Mather bomb calorimeter, with complete outfit, a Emerson bomb calorimeter, with complete outfit, a Parr calorimeter, an Abbe refractometer, a Torsion viscosimeter, a Tagliabue viscosimeter, a Tagliabue cold test apparatus, a Pensky Martin oil tester, a New York State oil tester, a Sartorius specific gravity balance, two Becker analytical balances, gas muffle furnace, Kny-Scherer oil tester, a Graefe gas calorimeter, a Orsat gas analysis apparatus, laboratory tables, lockers, and hoods.

The Industrial Chemistry Laboratory contains the following: one filter press, Type E. T. Shriver & Co., a single-acting triplex plunger pump, Goulds Manufacturing Company, a vacuum drying apparatus, a surface condenser, a Packard vacuum pump, Norman Hubbard's Sons, a vacuum evaporator, Swenson system, American Foundry and Machine Company, a centrifugal, C. H. Chavant & Co., a double jar mill, F. I. Stokes & Co.

For the purpose of carrying on dyeing on a basis which is more comparable with commercial practice there is provided a laboratory which includes the following equipment: a small kier, fitted with E. D. Jefferson's circulating device, an electrolyzer for manufacturing bleaching solutions, the National Laundry Machine Company, Dayton, Ohio, a Permutit filter, the Permutit Company, New York City, a mercerizing machine, a raw stock dyeing machine, Klauder-Weldon Dyeing Machine Company, Yardley, Pa., a yarn dyeing machine, Klauder-Weldon Dyeing Machine Company, a jig dyeing machine, the Textile-Finishing Machine Company, Providence, R. I., a set of drying cans by the same concern, a chain dyeing machine, T. C. Entwistle Company, Lowell, Mass., a raw stock drying table, Proctor & Schwartz, Philadelphia, Pa., a padding mangle, Arlington Machine Works, Arlington, Mass., a hydro-extractor, W. H. Tolhurst & Son, Troy, N. Y., a Psarski experimental dyeing machine, a Hussong experimental dyeing machine, equipped for raw stock or yarns, a Rodney Hunt sample piece dyeing machine, equipped with an automatic temperature and pressure-regulating apparatus, made by C. J. Tagliabue Manufacturing Company, Brooklyn, N. Y. The Franklin Process Company, Providence, R. I. have furnished a 25-pound bronze dyeing machine. Of the various dye tubs, one is equipped with a Monel Metal lining to withstand the action of various chemicals and dyes.

Finishing Department. — The Woolen and Worsted section includes a 2-string washer, a fulling mill, furnished by the Rodney Hunt Company, Orange, Mass.; a sample fulling mill, a kicker mill, furnished by James Hunter & Co., North Adams, Mass.; an up and down dry gig, a rolling and stretching machine, an up and down wet gig, a steam finishing machine, a 60-inch, 3-burner singeing machine, adapted for cotton, silk or worsted goods, a 2-cylinder double-acting brushing machine, a 60-inch, 4-cylinder sanding and polishing machine, furnished by Curtis & Marble, Worcester, Mass.; a 6/4 double shear, an A. W. C. measuring and weighing machine, furnished by Parks & Woolson, Springfield, Vt.; a dewing machine, a 6/4 Voelker rotary press, furnished by G. W. Voelker & Co., Woon-

socket, R. I.; a single shear, Curtis & Marble, donated by Massachusetts Mohair Plush Company, Lowell, Mass.; a tentering and drying machine furnished by John Heathcote, Providence, R. I.; a single crabbing machine, H. W. Butterworth & Son, Philadelphia, Pa.; a 72-inch woolen napper, Davis & Furber, North Andover, Mass.; a 32-inch basket hydro-extractor, W. H. Tolhurst, Troy, N. Y.; a Lintz & Eckhardt cloth numbering machine, improved by Durbrow & Hearne Manufacturing Company, New York; a steam press for underwear, United States Hoffman Company, Syracuse, N. Y.; a sewing machine, Birch Brothers, Somerville, Mass.

The Cotton section includes a 40-inch inspecting and brushing machine, a 44-inch No. 25 railway sewing and rolling machine, a 44-inch cotton shearing machine, Type No. 34, a 44-inch No. 3 steam calender rolling machine, a 40-inch cloth folder, a 40-inch winder and measurer, a set 44-inch shear blades for grinding purposes, furnished by Curtis & Marble, Worcester, Mass.; a 48-inch No. 4 opening, sewing and re-rolling machine, a No. 1 hand power portable railway sewing machine, furnished by Dinsmore Manufacturing Company, Salem, Mass.; a 40-inch, 3-roll water mangle, with husk and brass rolls and usual attachments and equipped with a 48-inch Mycock scutcher, and a 40-inch Mycock cloth expander made by Thomas Leyland & Co., Boston, a 40-inch, 2-roll starch mangle, a 40-inch upright drying machine with 10 copper cylinders equipped with Files dry can system, Files Engineering Company, Inc., Bridgeport, Conn., a 40-inch sprinkler, a 40-inch, 5-roll Universal calender with chasing attachment and equipped with a 40-inch Mycock cloth expander, and a pasting table with plate, furnished by the Textile-Finishing Machinery Company, Providence, R. I.; a 16 by 24 inch bronze-covered stretcher for the drying cans, C. A. Luther & Co., Providence, R. I.; a 40-inch double bristle stretcher for drying cans, American Finishing Machinery Company, Boston, Mass.; a 40-inch Tommy Dodd starch mangle, H. W. Butterworth & Sons Company, Philadelphia, Pa. and a 44-inch, 50-foot vibratory tentering machine. This machine is directly driven by a 7½-horse power variable speed motor and is equipped with a Schwartz automatic electric guider, made by L. H. A. Schwartz & Co., Boston, Mass.

Engineering Department. — The Steam Engineering Laboratory contains a 50-horse power Allis-Chalmers Corliss steam engine (Reliance type) for experimental purposes, arranged to operate condensing or non-condensing, and direct connected to an Alden absorption dynamometer, — connected to this steam engine there is a Wheeler surface condenser; a 25-kilowatt Kerr steam turbine (7 stage), direct connected to 25-kilowatt Richmond Electric Company alternating current generator, and arranged for both condensing and non-condensing conditions. The piping is also arranged that this turbine may be run as a low-pressure turbine, in conjunction with the Allis-Chalmers engine. The generator is especially designed for experimental work with connections and windings for all the commercial phases. In addition there is also a Deane triplex power pump, 4 by 6 inches, a 2-inch centrifugal pump, made by Lawrence Machine Company and direct connected to a 3-horse power General Electric 220-volt induction motor, a Clayton air compressor (belted type) 6 x 6 inches, a centrifugal pump, 2-inch (belted type), Lawrence Machine Company, Lawrence, Mass. There are the necessary pressure, storage, and weighing tanks together with flue gas collector, Orsat apparatus, pressure gauges, thermometers, indicators, etc. For the measurement of the flow of air there are two Sturtevant fan blowers and a Massachusetts motor-driven fan and heater combination, arranged for testing work on heating, drying, etc. For instruction in leveling and surveying there is provided three engineer's transits, leveling rods, etc.

The Electrical Engineering Laboratory consists of two sections one devoted to the measurement of generation and transmission of power and contains the necessary switchboard and instruments to control a 25-kilowatt alternating current generator which is driven by the steam turbine referred to above. There is also a 15-kilowatt motor generator set which is arranged to supply either direct or alternating current. The additional equipment of the laboratory consists of a 24-horse power, Allis-Chalmers, 220-volt direct-current motor, a 10-horse power, General Electric Company, compound wound, 220-volt, direct-current motor,

a 7.5-horse power and a 10-horse power General Electric induction motor, a 4-horse power General Electric rotary transformer arranged to supply either direct current or alternating current. The other section of the laboratory is known as the instrument laboratory and is used for the purpose of giving instruction in the measurement of current, voltage, resistance and in the calibration of direct and alternating current instruments and contains a 5-kilowatt 3-wire Crocker-Wheeler balancer set, a 160-ampere, 10-hour storage battery, a 5-kilowatt, 220 to 440-volt transformer, a Westinghouse portable polyphase wattmeter with current transformers, three General Electric alternating current wattmeters, two General Electric alternating current ammeters, a 300-750 scale General Electric voltmeter, a 5 to 10 scale Weston ammeter (electro dynamometer type), a 200-ampere Weston shunt, a 30-volt alternating current Roller Smith voltmeter, two 6–3 to 1 Westinghouse potential transformers, a 100-ampere Leeds & Northrup Standard Resistance, a Leeds & Northrup Ayrton shunt, a General Electric alternating current voltmeter, two 250-volt direct-current Weston portable voltmeters, a Weston direct-current portable millivoltmeter; 2 ampere and 20 ampere shunts for use with the above instrument, a 150-ampere direct-current Weston portable ammeter, two Weston model 45 direct-current ammeters, two Weston model 260 direct-current ammeters, a Weston model 260 direct-current voltmeter, a Thompson 50-ampere, 2-wire, 220-volt recording wattmeter, General Electric Company, a rotating standard wattmeter, two induction type watthour meters, General Electric Company, a Weston laboratory standard voltmeter with multiplier to 600 volts, a Leeds & Northrup potentiometer No. 7551, a wall galvanometer, Leeds & Northrup, No. 2210, D'Arsonval type, a Wheatstone bridge, Leeds & Northrup, No. 4725A, with D'Arsonval galvanometer, Leeds & Northrup tripod type, a slide wire bridge, Leeds & Northrup, an electro-dynamometer, Leeds & Northrup, a Weston Standard cell, a potential phase shifter, made by States Company, Hartford, Conn., a standard Leeds & Northrup photometer with Lummer-Brodhun screen compound rotator and rotating sector, screens, etc., a Macbeth illuminometer, Leeds & Northrup, an Esterline portable curve drawing wattmeter designed for polyphase alternating-current or direct-current power measurements.

Machine Shop. — The equipment of the machine shop is as follows: Four standard engine lathes, 13-inch swing, 6-foot bed, from Flather & Co., Nashua, N. H.; three standard engine lathes, 14-inch swing, 6-foot bed, from Flather & Co., Nashua, N. H.; a standard engine lathe, 15-inch swing, 6-foot bed, from F. E. Reed Company, Worcester, Mass.; an engine lathe, 18-inch swing, 10-foot bed, from Flather & Co., Nashua, N. H.; an engine lathe, 18-inch swing, 6-foot bed, from Champion Tool Works, Cincinnati, Ohio; a standard engine lathe, 15-inch swing, 6-foot bed, from S. H. Putnam Sons, Fitchburg, Mass.; five speed lathes, 17-inch swing, 5-foot bed, from J. G. Blount, Everett, Mass.; one No. 1 Universal milling machine, with all three feeds automatic, from Kempsmith Manufacturing Company, Milwaukee, Wis.; one 24 by 24 inch, 6-foot planer, from the Mark Flather Planer Company, Nashua, N. H.; one 23-inch upright drill, with back gears and power feed, from J. E. Snyder & Son, Worcester, Mass.; one 14-inch single sensitive drill, from the Stanley Manufacturing Company, Lawrence, Mass.; one No. 1 Universal grinder, from Landis Tool Company, Waynesboro, Pa.; one 20-inch wet tool grinder, from J. G. Blount, Everett, Mass.; one 12-inch, 2-wheel dry grinder, from J. G. Blount, Everett, Mass.; an American twist drill grinder, from the Heald Machine Company, Worcester, Mass.; one Type 1B portable electric grinder from the Cincinnati Electric Tool Company, Cincinnati, Ohio; one 30-inch grindstone and frame, from the Athol Machine Company, Athol, Mass.; a single spindle centering machine, from D. E. Whiton Machine Company, New London, Conn. one 15-inch shaper, from Potter & Johnson, Pawtucket, R. I.; one power hacksaw, from the Fairbanks Company, Boston, Mass.; one cold saw, from John T. Burr & Son, Brooklyn, N. Y.; one Eureka metal power saw, Manning, Maxwell & Moore; one Type CC electric drill, Cincinnati Electric Tool Company; one Universal milling attachment for Kempsmith milling machine, Taylor Machinery Company; one Hisey Type B ½-horse power tool post grinder, Taylor Machinery Company; one No. 2 Cory bench straightener, Manning, Maxwell & Moore; one No. 3 Universal cutter and reamer grinding machine, Brown and Sharpe; a well-

equipped tool room containing a selected stock of the best makes of small tools, such as drills, taps and dies, milling cutters, reamers, gauges, micrometers, etc.

Power, Light, Heat and Ventilating Plant. — In the new power house, completed in 1913, there is located the main power-generating apparatus for supplying light, heat and power to all departments of the school. The equipment here consists of: two 250-horse power Heine water tube boilers, equipped with Perfection grates, a 300-horse power Aultman & Taylor horizontal water tube boiler, equipped with United States rocking grates, two boiler feed pumps — one a Knowles and the other a Deane, a 40,000-pound Cochrane metering open-feed water heater, which is provided with a Lea recorder and a Cochrane oil extractor heats and measures all feed water, a 3-inch Venturi meter in feed line with indicating manometer as made by the Builders Iron Foundry, Providence, R. I. In the Engine Room are located: a Payne 14 by 14 automatic high speed engine, 125-horse power direct connected to 75-kilowatt, 220-volt, direct-current Bullock generator, a $9\frac{1}{2}$ by 11 Nash gas engine of 50-horse power, 4-cycle type, with speed-regulating clutch and a "hit and miss" governor, direct connected to a 30-kilowatt, 220-volt, direct-current Bullock generator, a 65-kilowatt motor generator set, consisting of a direct current motor and an alternating current generator. This unit may be run either A. C. to D. C. or D. C. to A. C., and was made by the Westinghouse Electric and Manufacturing Company. A steam-driven Ingersoll-Rand 8 by 8 air compressor, for use with Turbo heads, installed in the French Spinning Department by the G. M. Parks Company, Fitchburg, Mass., a $5\frac{1}{2}$ to 6 motor-driven air compressor, with 20 cubic foot storage tank for use in starting Nash gas engine, a Cross oil filter. The station switchboard is of marine-finished slate, 90 inches in height, and consists of three generator panels and two circuit panels.

The power house is connected with the main school buildings by a tunnel through which all wires, steam and water pipes are carried. The steam pipes supply heat to the buildings by means of direct radiation, and by means of the Sturtevant double duct heating and ventilating system located in the basement of Southwick Hall, and by the Sturtevant fan and heater located in the basement of Kitson Hall. Direct-driven exhaust fans are placed on the roof of Southwick Hall and in the basement laboratories.

ALUMNI ASSOCIATION.

The Alumni Association of the School holds its annual meeting and banquet in February of each year in Boston, Mass.

The membership of the association is restricted to graduates of the day school. Honorary membership is open to the Board of Trustees, the faculty and such others as may be elected by the association.

The officers for the years 1922–23 are: —

President, Irving N. Stronach, '10.
Vice-President, Philip H. Warren, '05.
Secretary-Treasurer, Arthur A. Stewart, '00.

Board of Directors: the President, Vice-President, Secretary-Treasurer, William Walker, Jr., '06, for one year, George A. Boyd, '05, for two years. Communications should be addressed to Arthur A. Stewart, Lowell Textile School.

Entertainment Committee.

Arthur J. Hennigan, '06, *Chairman;* Royal P. White, '04; Everett B. Rich, '11; James F. Dewey, '04; Harold W. Cheney, '06.

GRADUATES, JUNE 5, 1923.

Graduates, with Titles of Theses.

Bachelor of Textile Engineering.

Alexander Campbell, South Boston. "Comparative Tests on Linen and Cotton Shoe Threads." (With Philip S. Cannell.)

Philip Stuart Cannell, Everett. Thesis with Alexander Campbell.

Chi Chang, China. "Effect of Fabric Construction upon its Tensile Strength and Elongation." (With Chieh-Ching Kao and Cho Wang.)
Leon Arthur Davieau, Marlborough. "An Investigation of the Ring Dandy Rover." (With Claude C. Farwell.)
Claude Chapman Farwell, Groton. Thesis with Leon A. Davieau.
Harold Downes Forsyth, Swampscott. "Power Factor and Efficiency, and their Relation to Textile Mill Operation." (With Ray B. Farwell.)
Nassib Haddad, Iselin, N. J. "A Study of Worsted Cap and Ring Twisting." (With John J. McCann, Jr.)
Hsueh-Chang Hsu, China. "A Comparative Study of the Properties of Yarns of Equivalent Counts." (With Tung-Chuan Wang.)
Chieh-Ching Kao, China. Thesis with Chi Chang and Cho Wang.
Joseph Carleton Knox, Somerville. "A Study of the Power Consumption in a Cotton Spinning Frame." (With Leland H. Chapman.)
Carleton Joshua Lombard, Saco, Me. "The Determination of the Relative Strengths of Cotton Duck Constructed with Different Picks and Different Ends per Inch." (With Burnet Valentine.)
Burnet Valentine, Mt. Vernon, N. Y. Thesis with Carleton J. Lombard.
Cho Wang, China. Thesis with Chi Chang and Chieh-Ching Kao.
Tung-Chuan Wang, China. Thesis with Hsueh-Chang Hsu.
Joseph Albert Webster, Lawrence. "Development of a Machine and Methods for Determining the Effect of Abrasion upon the Strength of Textile Fabrics." (With Walter F. Wheaton.)
Walter Francis Wheaton, Worcester. Thesis with Joseph A. Webster.
Joseph Arthur Woodhead, Chelmsford. "A Study of the Relation of Twist to Contraction in a Cotton Yarn."

Bachelor of Textile Chemistry.

Andrew Edward Barrett, Lowell. "The Mechanism of the Sulphur Dye Bath."
Arthur Edward Cohen, Boston. "Possibilities of Preparing Sulphur Red."
Robert Kingsbury Houghton, Stoneham. "Carbonizing with Metallic Chlorides."
Jacob Hurwitz, Boston. "Relation of Temperature of Absorption to Constitution of Acid Dyes."
Robert William Jaeger, Jr., Mattapan. "A Study of Methods of Cross-sectioning Textiles for Photomicrographic Purposes."
Sven Albert Laurin, Lowell. "The Use of the Spectograph in Identifying Dyes."
Barney Harold Perlmutter, Dorchester. "Possibilities of Preparing Sulphur Red."
Lawrence Francis Ryan, Somerville. "Tungsten and Its Application to Textiles."
Chen Wang, China. "Black Dyeing of Silk."

Diploma Graduates.

Cotton Manufacturing.

Newton Gary Hardie, Birmingham, Ala. "The Manufacture of a Colonial Coverlet." (With Howard R. Hart.)
Howard R. Hart, New Hartford, N. Y. Thesis with Newton G. Hardie.
Louis Joseph Othote, Nantucket. "The Manufacture of a Mercerized Shirting."

Wool Manufacturing.

David Annapolsky, Winthrop. "The Manufacture of a Woolen Suiting."
Henry Jones Atwood, Waltham. "The Manufacture of a Woolen Cheviot."
John Lawrence Blanchard, Quincy. "The Manufacture of a Worsted Cheviot."
Philip Franklin Brown, Lowell. "The Manufacture of an Unfinished Worsted."
Harold Poehlmann Goller, Freeport, N. Y. "The Manufacture of an Unfinished Worsted."
Chester Twombly Hammond, Somerville. "The Manufacture of a Woolen Cassimere."

Charles Henry Kendall, Somerville. "The Manufacture of an Unfinished Worsted."
Henry Macher, Clifton, N. J. "The Manufacture of a Worsted Suiting."
James Bryan Savery, Russell. "The Manufacture of a Woolen Cassimere."
Lambert William Sullivan, Pepperell. "The Manufacture of a Worsted Cheviot."
Willard David Sullivan, Lowell. "The Manufacture of a Woolen Cassimere."
Raymond Scott Walker, Lowell. "The Manufacture of a Woolen Cassimere."

Textile Design.

Walter Ernest Todd, Webster.

Prizes awarded in June, 1923.

The Medal of the National Association of Cotton Manufacturers awarded to the student taking course in Cotton who maintains the highest average in scholarship throughout his course. *To Burnet Valentine.*

The Edward A. Bigelow Prizes. — $75 to the member of the graduating class pursuing the Wool Manufacturing course who shall have attained the highest average in scholarship during his three years. To *Charles Henry Kendall.* $50 to the member of the second year class in the Wool Manufacturing course who maintains the highest average in scholarship during his second year. To *Edward Francis Moore.* $25 to the member of the first year class in the Wool Manufacturing course who maintains the highest average in scholarship during his first year. To *William Albert Robinson.*

Saco-Lowell Prize of $100 to the student or students presenting the best Engineering thesis preparatory to graduation. To *Hsueh-Chang Hsu* and *Tung-Chuan Wang.* Honorable Mention, *Claude Chapman Farwell* and *Leon Arthur Davieau, Harold Downes Forsyth* and *Ray Baldwin Farwell.*

The Louis A. Olney Book Prizes offered to students taking the regular Chemistry and Textile Coloring course.

$20 to the student presenting the best thesis preparatory to graduation. To *Chen Wang.*

$10 to the student who shall be considered as having attained the highest scholarship in first year chemistry. To *Norman Spaulding Buchan.*

$5 to the student who shall be considered as having attained the second highest scholarship in first year chemistry. To *William Charles Smith.* Honorable Mention, *Philip Edwin Mason, Samuel Meeker.*

$10 to the student who shall be considered as having attained the highest scholarship in second year chemistry. To *Joseph Bailey Crowe.*

$5 to the student who shall be considered as having attained the second highest scholarship in second year chemistry. To *Robert Edward Sargent.* Honorable Mention. *Haven Asa Morrison.*

REGISTER OF STUDENTS.

Seniors.

Candidates for Degree.

Name, Home Address, Course, Lowell Address.

Anderson, Arthur Illman, Wakefield, Mass., IV.
Anderson, Clarence Alfred, Norwood, Mass., VI., Y. M. C. A.
Babigan, Raymond, Lowell, Mass., IV., 121 Bellevue Street.
Bachelder, Charles Edward, Lowell, Mass., IV, 98 Stevens Street.
Bailey, Lester Harold, Lowell, Mass., IV, 14 Sidney Street.
Bell, Edward Benjamin, Lowell, Mass., IV, 64 Humphrey Street.
Booth, James Mooney, Boonton, N. J., IV, Phi Psi House.
Brigham, Howard Mason, Upper Montclair, N. J., VI, 84 School Street.

Chapman, Leland Hildreth, Pepperell, Mass., VI, 236 Salem Street.
Chen, Wen Pei, Shanghai, China, IV, 133 White Street.
Clement, David Scott, Providence, R. I., IV, 137 Riverside Street.
Datar, Anant Vithal, Inchalkaranji, India, VI, 32 Princeton Street.
Donovan, Joseph Richard, Dorchester, Mass., IV, Delta Kappa Phi House.
Dunnican, Edward Tunis, Passaic, N. J., VI, Phi Psi House.
Durgin, William Ernest, Lowell, Mass., IV, 117 Bowers Street.
Farwell, Ray Baldwin, Groton, Mass., VI, 236 Salem Street.
Feindel, George Paul, North Wilmington, Mass., IV, 141 Pawtucket Street.
Feldstein, Martin Alexander, Lakewood, N. J., VI, 22 Mt. Vernon Street.
Fowle, Edwin Daniels, Malden, Mass., VI.
Hall, Frederick Kilby, Milton, Mass., VI, Omicron Pi House.
Hathorne, Berkeley Lewis, Stoneham, Mass., IV.
Johnson, Philip Stanley, Lynn, Mass., IV, 3 Belmont Street.
Lewis, George Kenneth, Nashua, N. H., VI, Omicron Pi House.
Lowe, Philip Russell, Andover, Mass., VI.
McCann, John Joseph, Jr., Lowell, Mass., VI, 90 Beech Street.
Miller, Joshua, Dorchester, Mass., VI, Sigma Omega Psi House.
Runnells, Harold Nelson, Concord, N. H., IV, 64 Foster Street.
Steele, Everette Vernon, Marblehead, Mass., IV, 141 Pawtucket Street.
Toupin, Stephane Frederick, Lowell, Mass., VI, 320 Hildreth Street.
Villa, William Horace, New York City, VI, 100 Riverside Street.
Wilcox, Leonard Edward, Lowell, Mass., VI, 42 Riverside Street.

Diploma Students.

Andrews, Walter Shirley, Lowell, Mass., II, 26 Grove Street.
Archambault, Frederick Arthur, Methuen, Mass., II.
Beck, Frederic Christian, Southbridge, Mass., II, Delta Kappa Phi House.
Bienstock, George Jerrard, New York City, III, Sigma Omega Psi House.
Bradford, Harold Palmer, Andover, Mass., II.
Burger, Samuel Joseph, Brooklyn, N. Y., III, Sigma Omega Psi House.
Carr, Paul Edward, Cambridge, Mass., II.
Cody, Winthrop Prescott, Newton Highlands, Mass., II, Omicron Pi House.
Doane, Walter Bradford, Milford, Mass., II, 52 Mt. Washington Street.
Dowd, Francis Joseph, Boston, Mass., II.
Duguid, Harry Wyatt, Fitchburg, Mass., I, Omicron Pi House.
Fletcher, Howard Varnum, Lowell, Mass., III, 398 Princeton Street.
Gilman, Clarence Faulkner, West Roxbury, Mass., I, Delta Kappa Phi House.
Harmon, Guy Hedrick, Bennington, Vt., II, Phi Psi House.
Horne, James Albert, Malden, Mass., I, Omicron Pi House.
Hubbard, Barton Drew, Lowell, Mass., I, 31 Arlington Street.
McKinstry, James Bradley, Southbridge, Mass., II, Delta Kappa Phi House.
Martin, Walter Wellington, West Somerville, Mass., II.
Mitchell, Charles Alvah, Somerville, Mass., II.
Moore, Edward Francis, Rockford, Ill., II, Delta Kappa Phi House.
Olson, Carl Oscar, West Somerville, Mass., II, Omicron Pi House.
Reynolds, Raymond, Lowell, Mass., II, 37 Marlborough Street.
Rivers, William Anthony, Montpelier, Vt., II, Delta Kappa Phi House.
Ryan, Millard Kenneth Thomas, Natick, Mass., II, 37 Varney Street.
Smith, Frank Kenfield, Montpelier, Vt., II, Phi Psi House.
Stainton, William George, Bradford, Mass., III.
Sweeney, George Hamilton, Cambridge, Mass., II.
Villeneuve, Maurice Arthur, Dorchester, Mass., II, Delta Kappa Phi House.
Ziock, Roy, Rockford, Ill., II, Delta Kappa Phi House.

Juniors.

Baker, Maurice Sidney, Dorchester, Mass., IV.
Cohen, Raphael Edvab, Lowell, Mass., IV, 63 Ware Street.
Coupe, George Edward, Jr., Lowell, Mass., VI, 16 West Bowers Street.
Crowe, Joseph Bailey John, Lowell, Mass., IV, 220 Thorndike Street.
Del Plaine, Parker Hayward, Lowell, Mass., IV, 14 Mt. Washington Street.

Ellis, Dorothy Myrta, Lowell, Mass., VI, 61 Ellis Avenue.
Hibbard, Frederick William, Lawrence, Mass., IV.
Hindle, Milton, Pawtucket, R. I., VI, Phi Psi House.
Hollstein, William Diedrick, Jersey City, N. J., VI, 822 Merrimack Street.
Kao, Chang-Keng, Tsinan, China, IV, 9 Conduit Street.
Li, Ko-Chia, Chilin, China, VI, 64 Seventh Avenue.
Liu, Chester F. T., Hankow, China, VI, 76 Endicott Street.
Morrison, Haven Asa, Merrimac, Mass., IV, 86 Grand Street.
Nieh, Hung Kuei, Kuei-Yang, China, VI, 332 Pawtucket Street.
Pierce, George Whitwell, Everett, Mass., IV.
Sandlund, Carl Seth, Nashua, N. H., VI.
Sargent, Robert Edward, Haverhill, Mass., IV.
Scanlon, Andrew Augustine, Lawrence, Mass., IV.
Villa, Luis Jorge, New York City, IV, 100 Riverside Street.
Weinstein, Edward Joseph, Harrison, N. Y., VI, Sigma Omega Psi House.
Wu, Clarence W. L., Hankow, China, VI, 337 Riverside Street.
Wu, Tsung-Chieh, Shanghai, China, VI, 135 White Street.

Sophomores.

Anderson, Harold Robert, Lowell, Mass., II, 22 Rose Avenue.
Antulonis, William Vincent, Stoughton, Mass., III, Delta Kappa Phi House.
Baker, Franz Evron, Hudson, Mass., VI, 237 Branch Street.
Baker, William Samuel, Somerville, Mass., VI.
Bouteiller, Earle Kenneth, Hartford, Conn., VI, 43 Plymouth Street.
Bradshaw, Hugh Edwin Henry, Brookline, Mass., I, Phi Psi House.
Brosnan, William Francis, Lowell, Mass., IV, 38 Second Avenue.
Buchan, Norman Spaulding, Andover, Mass., IV.
Burmon, Albert Nathaniel, Brookline, Mass., II, Delta Kappa Phi House.
Carter, Russell Albert, Andover, Mass., II.
Chang, Frank Tse-Jui, Shanghai, China, VI, 76 Endicott Street.
Coté, Theodore Charles, Groveland, Mass., IV.
Feustel, Kurt Erick, Passaic, N. J., VI, Phi Psi House.
Fleming, Hermon Anthony, Jr., Somerville, Mass., II.
Gallagher, Raymond Thomas, Lowell, Mass., II, 117 Methuen Street.
Godfrey, Harold Thomas, North Andover, Mass., VI.
Gordon, Ellis Judson, Hazardville, Conn., II, Omicron Pi House.
Gwinnell, George Harry, Pittsfield, Mass., II, 90 Mt. Vernon Street.
Horne, Albert Andrew, Nashua, N. H., II.
Hughes, Joseph Howard, Malden, Mass., II.
Isaacson, George Franklin, Waltham, Mass., II.
Joy, Thomas, Medford, Mass., VI, 237 Branch Street.
Kennedy, Francis Charles, Holyoke, Mass., VI, 25 Woodward Avenue.
Kuo, Limao, Taichowfu, China, VI, 332 Pawtucket Street.
Linsey, Edward, Malden, Mass., II, Sigma Omega Psi House.
Lundgren, Paul Henry, Waltham, Mass., II, Omicron Pi House.
McKay, Benedict Josephus, Stoughton, Mass., IV, 28 Mt. Grove Street.
Mason, Philip Edwin, Malden, Mass., IV, Omicron Pi House.
Mazer, Samuel, Roxbury, Mass., IV.
Meeker, Samuel, Lowell, Mass., IV, 248 Foster Street.
Merrill, John Leslie, Lowell, Mass., VI, 96 Dingwell Street.
Moore, Cyril Valentine, Westerly, R. I., I, Phi Psi House.
Murphy, Thomas Horatio, Fall River, Mass., I, 118 Mt. Washington Street.
Parkin, Robert Wilson, Maynard, Mass., VI, 315 Pawtucket Street.
Perry, Herbert Brainerd, Jr., Lowell, Mass., I, Phi Psi House.
Robinson, William Albert, Lowell, Mass., II, 16 Mt. Washington Street.
Schreiter, Ehrich Ernest Max, Walpole, Mass., VI, Y. M. C. A.
Shenker, Nahman, New York City, III, Sigma Omega Psi House.
Simpson, William Martin, Jr., Malden, Mass., II, Phi Psi House.
Smith, Ambrose Trowbridge, Pawtucket, R. I., IV, 37 Varney Street.
Smith, William Charles, Chadwicks, N. Y., IV, 51 Sixth Avenue.
Somers, Benjamin, Brookline, Mass., II.

Sturtevant, Fred William, Lowell, Mass., IV, 60 Grove Street.
Sullivan, Richard O'Brien, Groton, Mass., II, 434 Fletcher Street.
Sutcliffe, Henry Mundell, Millbury, Mass., II, 586 Merrimack Street.
Swain, Harry LeRoy, Jr., Kent, Ohio, I, 90 Mt. Vernon Street.
Teague, Charles Baird, Somerville, Mass., II.
Thomas, Theodore Holden, Bennington, Vt., II, Phi Psi House.
Thurston, Henry, New York City, I, Phi Psi House.
Trotsky, David Albert, Brooklyn, N. Y., III, Sigma Omega Psi House.
Willey, Everett Merle, Haverhill, Mass., II, Delta Kappa Phi House.
Wilman, Rodney Bernhardt, Brookline, Mass., II, Phi Psi House.
Wood, Richard Farmer, Concord, Mass., III, Omicron Pi House.
Woods, Chandler, Newton Center, Mass., II, Omicron Pi House.
Wright, William Eaton, Waltham, Mass., VI.
Yacubian, Levon Mardvois, Somerville, Mass., II.

Freshmen.

Bachmann, Alfred Richard, Lowell, Mass., III, 38 Plymouth Street.
Battles, Samuel Cook, North Andover, Mass., II.
Bentley, Byron, Methuen, Mass., II.
Blessington, John James, Lowell, Mass., VI, 53 Second Avenue.
Boone, Douglass Mabee, Albany, N. Y., II, Phi Psi House.
Bradford, William Herbert, Jr., Portland, Me., II, Phi Psi House.
Brodney, Oscar, Roxbury, Mass., VI.
Bullard, Edward Allen, Wrentham, Mass., VI, 137 Riverside Street.
Burke, Francis Harold, Franklin, Mass., III, 150 Pawtucket Street.
Burns, Philip Loring, East Milton, Mass., VI, 147 Riverside Street.
Callahan, John Joseph, Jr., Somerville, Mass., II.
Carle, Earl Richards, Melrose Highlands, Mass., III, 8 Mt. Washington Street.
Carmichael, Robert Ernest, Somerville, Mass., IV.
Colbert, Nathaniel Andrew, Somerville, Mass., II.
Connor, Thomas Francis, Roxbury, Mass., VI, 503 Beacon Street.
Connorton, John Joseph, Jr., Concord Junction, Mass., VI, 37 Varney Street.
Cranska, Floyd, Manchaug, Mass., I, 51 Sixth Avenue.
Currier, George Raymond, Lowell, Mass., IV, Delta Kappa Phi House.
Darby, Avard Nelson, Billerica, Mass., II.
Davis, Robert Lincoln, Waltham, Mass., III.
Derrickson, Howard Pool, Millville, Dela., I, 28 Mt. Grove Street.
Dolan, William Francis, Lowell, Mass., IV, 56 Crowley Street.
Estabrook, William Warren, Thetford, Vt., III, 236 Salem Street.
Farley, Clifford Albert, Lowell, Mass., VI, 215 Princeton Street.
Flood, Thomas Henry, Lowell, Mass., IV, 49 Madison Street.
Flynn, Thomas Joseph, Pittsfield, Mass., IV, 86 School Street.
Ford, Stephen Kenneth, Haverhill, Mass., IV.
Franks, Jerome, Brooklyn, N. Y., VI, 106 Crawford Street.
Fredrickson, Charles Joseph, Jr., Shawsheen Village, Mass., IV.
Gilman, Ernest Dana, Methuen, Mass., II.
Gladwin, Albert Bangs, North Weymouth, Mass., II, 236 Salem Street.
Glickman, Bernhardt, Mattapan, Mass., IV.
Glover, Robert, Brighton, Mass., VI.
Goldenburg, Louis, Dorchester, Mass., VI, 505 Fletcher Street.
Goodwin, Whitman Garton, West Somerville, Mass., III.
Gramstorff, George Herman, Everett, Mass., I.
Graves, Albro Newton, Providence, R. I., I, 42 Riverside Street.
Greenwood, John Roger, Jr., Millbury, Mass., II, 42 Riverside Street.
Guild, Lawrence Winfield, Wollaston, Mass., VI, 8 Mt. Washington Street.
Hathaway, William Taber, Somerville, Mass., VI.
Heap, Hargreaves, Jr., Atlantic, Mass., VI, 118 Mt. Washington Street.
Hooper, Clarence, Shirley, Mass., IV.
Howes, Edwin Ernest, Woodstock, Vt., VI, 28 Mt. Grove Street.
Hyde, Alvin Manning, East Brimfield, Mass., II, 236 Salem Street.
Johnson, Alvin, Waltham, Mass., II.

Jones, Harry Herman, Albany, N. Y., VI, 137 Riverside Street.
Kenney, Frederick Leo, Franklin, Mass., II, 52 Mt. Washington Street.
King, John Walter, Dorchester, Mass., II.
Kingsbury, Stanley Charles, Malden, Mass., II.
Lawlor, John Warren, Somerville, Mass., VI.
Leavitt, George Herbert, Old Town, Me., II, 37 Varney Street.
Lees, Douglas Ormiston, Holyoke, Mass., IV, 25 Woodward Avenue.
Leonard, Leo Edward, Worcester, Mass., III, 236 Salem Street.
Lord, George Frederic, Lawrence, Mass., VI.
Lussier, Joseph Adrien, Woonsocket, R. I., II, 793 Merrimack Street.
MacKenzie, Ronald Smith, Concord Junction, Mass., VI, 37 Varney Street.
McGuire, Edward Perkins, Brookline, Mass., VI, 159 White Street.
McKinnon, Norman, Lowell, Mass., VI, 1782 Middlesex Street.
Mason, Russell Kinsley, North Andover, Mass., IV.
Meyers, Chester William, Billerica, Mass., IV.
Musgrave, George William, Webster, Mass., IV, 51 Sixth Avenue.
Noyes, Leighton Helmoth, Brattleboro, Vt., II, 159 White Street.
Parikian, Harold Hrant, Hudson, Mass., IV, 52 Mt. Washington Street.
Parsons, Charles Sumner, East Milton, Mass., VI, 793 Merrimack Street.
Patenaude, Harold John, Ashuelot, N. H., VI, 825 Merrimack Street.
Peterson, Halvar Alfred, Waltham, Mass., II.
Redding, Leslie Capron, Woonsocket, R. I., II, 793 Merrimack Street.
Reinhold, Kurt Herman, Clifton, N. J., VI, 142 Riverside Street.
Robbins, Donald Emerson, Lawrence, Mass., II.
Robinson, Marjorie Lorettor, West Somerville, Mass., IV, 193 Avon Street.
Rossi, Lawrence Louis, West Roxbury, Mass., II, 48 Columbia Road.
Ryan, David Louis, Natick, Mass., II, 37 Varney Street.
Sawyer, Richard Morey, Winchester, Mass., VI.
Schneiderman, Jacob, Dorchester, Mass., III.
Shea, John Francis, Fitchburg, Mass., IV, 52 Mt. Washington Street.
Sheehan, John, Harvard, Mass., II.
Sheindelman, Ephraim Frank, New York City, IV, 56 Plain Street.
Simpson, Robert, Lowell, Mass., I, 201 Nesmith Street.
Skinner, Everett William, Rockville, Conn., VI, 51 Sixth Avenue.
Slack, John Taylor, 2d, Springfield, Vt., VI, 43 Plymouth Street.
Slamin, Alfred Francis, Wellesley, Mass., I, 37 Varney Street.
Smith, Allen Batterman, Winchester, Mass., I.
Solomon, Joseph, New York City, III, 543 Fletcher Street.
Stass, John George, Lisbon Falls, Me., II, 250 West Sixth Street.
Supple, Leo Paul, Franklin, Mass., II, 52 Mt. Washington Street.
Tanguay, Gerard, Woonsocket, R. I., IV, Phi Psi House.
Tarpey, Thomas Joseph, Somerville, Mass., IV.
Vangor, John, Bridgeport, Conn., IV, Phi Psi House.
Vincent, William Henry, Hyde Park, Mass., II, 25 Putnam Avenue.
Windbiel, Raymond Francis, Chicago, Ill., IV, 118 Mt. Washington Street.
Wingate, Edward Lawrence, Jr., Malden, Mass., VI.
Woodbury, Kenneth Leroy, Bradford, Mass., VI.
Wyatt, Andrew Harper, Fitchburg, Mass., II.

Special Students.

Baldwin, Rignal Woodward, Jr., Baltimore, Md., I, 43 Plymouth Street.
Chu, Chung-Yu, Hankow, China, IV, Y. M. C. A.
Cody, Marguerite Marie, North Adams, Mass., IV, 193 Avon Street.
Coggeshall, Eleanor Holkins, Framingham, Mass., III, 473 Beacon Street.
Dole, Robert Heman, Bristol, N. H., IV, 51 Sixth Avenue.
Gary, Frank Boyd, Jr., Abbeville, S. C., I, 142 Riverside Street.
Gerrits, Henry Richard, Yonkers, N. Y., II, Delta Kappa Phi House.
Herrmann, Albert Edward, Jr., New York City, IV, 90 Mt. Vernon Street.
Kefalaias, Nicholas, Lowell, Mass., VI, 62 Willie Street.
Kobayashi, Isami, Takushima, Japan, II, 150 Pawtucket Street.
Lariviere, George Joseph, Danielson, Conn., I, 125 Mt. Washington Street.

Nathan, Emanuel Geoffrey, Boston, Mass., II.
Pooler, Leonard Lawrence, Lowell, Mass., IV, 121 Mt. Washington Street.
Ray, Edna, Manistee, Mich., III, 193 Avon Street.
Turner, Carl Frederick, Lowell, Mass., II, 92 Stevens Street.

ALPHABETICAL LIST OF GRADUATES.

The following list has been corrected in accordance with information received previous to March 1, 1924. Any information regarding incorrect or missing addresses is earnestly solicited.

B.T.C. indicates the degree of Bachelor of Textile Chemistry; B.T.D. indicates the degree of Bachelor of Textile Dyeing; B.T.E. indicates the degree of Bachelor of Textile Engineering; D indicates a diploma; C indicates a certificate (covering a partial course only). Degrees were issued beginning with the year 1913.

Abbot, Edward Moseley, II, '04 (D). Vice-President and Agent, Abbot Worsted Company, Graniteville, Mass.
Abbott, George Richard, II, '08 (D). Andover, Mass.
Adams, Floyd Willington, VI, '16 (B.T.E.). Superintendent, The Barrett Company, Peoria, Ill.
Adams, Henry Shaw, I, '05 (D). Secretary and Treasurer, The Springstein Mills, and Eureka Cotton Mills, Chester, S. C.
Adams, Tracy Addison, IV, '11 (D). Division Superintendent, Arnold Print Works, North Adams, Mass.
Albrecht, Charles Henry, IV, '17 (B.T.C.). Chemist, Wood Worsted Mills, Lawrence, Mass.
Almquist, George John Edwin, I, '19 (D).
Anderson, Arthur Julius, IV, '19 (B.T.C.). Chemist, Thermo Mills, Inc., West Sand Lake, N. Y.
Annapolsky, David, II, '23 (D).
Arienti, Peter Joseph, IV, '10 (D). Chief Chemist and Dyer, Sayles Finishing Plants, A and B, Saylesville, R. I.
Arundale, Henry Barnes, II, '07 (D). 59 Salem Street, Andover, Mass.
Atwood, Henry Jones, II, '23 (D). Designer and assistant to Superintendent, Sutton's Mills, North Andover, Mass.

Bailey, Joseph W., I, '99 (D). Agent, Butler Mill, New Bedford, Mass.
Bailey, Walter James, IV, '11 (D). With Bailey's Cleansers & Dyers, Watertown, Mass.
Baker, William John, IV, '16 (D).
Baldwin, Frederick Albert, II, '04 (D). Vice-President and Secretary, Walter Blue & Co., Ltd., Sherbrooke, Que.
Barlofsky, Archie, VI, '17 (B.T.E.). Merchant, Economy Cash Market, 165 Chelmsford Street, Lowell, Mass.
Barr, I. Walwin, I, '00 (D). Manager, Mill Department, F. U. Stearns & Co., 9 Thomas Street, New York City.
Barrett, Andrew Edward, IV, '23 (B.T.C.). Color Chemist, Grasselli Chemical Company, Boston, Mass.
Bennett, Edward Howard, II, '03 (C). Publisher, Frank P. Bennett & Co., 530 Atlantic Avenue, Boston, Mass.
Berry, Wilbur French, II, '17 (D). Manager, Wilbur Manufacturing Company, Providence, R. I.
Bird, Clarence Henry, II, '22 (D). In Superintendent's Office, Worcester Woolen Mill Company, Worcester, Mass.
Bird, Francis John, VI, '22 (B.T.E.). With Slater Yarn Company, Pawtucket, R. I.
Blaikie, Howard Mills, II, '11 (D). Salesman, American Woolen Company, 225 4th Avenue, New York City.
Blake, Parker Gould, VI, '14 (D). Manufacturers' Agent, Claude Denis & Co., 409 McKinnon Building, Toronto, Ont.
Blanchard, John Lawrence, II, '23 (D). Assistant Designer, Everett Mills, Lawrence, Mass.

Bodwell, Henry Albert, II, '00 (D). Treasurer and General Manager, Smith & Dove Manufacturing Company, Andover, Mass.

Boyd, George Andrew, I, '05 (D). Assistant Treasurer, Harmony Mills, 201 Devonshire Street, Boston, Mass.

Brackett, Martin Richard, II, '22 (D). With D. S. Mackay & Co., 215 Fourth Avenue, New York City.

Bradford, Roy Hosmer, II, '06 (D). Superintendent, Linen Thread Plant, Smith & Dove Manufacturing Company, Andover, Mass.

Bradley, Raymond Frost, VI, '14 (D). Garage Proprietor, Twin Light Garage Company, 267 East Main Street, Gloucester, Mass.

Bradley, Richard Henry, V, '01 (C). Overseer, Wamsutta Manufacturing Company, New Bedford, Mass.

Brainerd, Arthur Travena, IV, '09 (D). Manager of Chicago office, H. A. Metz & Co., 449 North La Salle Street, Chicago, Ill.

Brainerd, Carl Emil, IV, '20 (B.T.C.). Overseer of Dyeing, F. C. Huyck & Sons, Albany, N. Y.

Brainerd, Carroll Lewis, IV, '19 (B.T.C.). With Waldrich Bleachery, Delawanna, N. J.

Brandt, Carl Dewey, VI, '20 (B.T.E.). General Foreman and Chemist, Lowell Bleachery South, Experiment, Ga.

Brannen, Leon Vincent, III, '07 (C).

Brickett, Chauncy Jackson, II, '00 (D). Principal, School of Textiles, International Correspondence School, Scranton, Pa.

Brickett, Raymond Calvin, II, '14 (D). Overseer, M. T. Stevens & Sons Company (Marland Mills), Andover, Mass.

Brown, Gerald Marston, VI, '22 (B.T.E.). With Monomac Spinning Co., Lawrence, Mass.

Brown, Philip Franklin, II, '23 (D). Salesman, D. S. Mackay & Co., 215 Fourth Avenue, New York City.

Brown, Rollins Goldthwaite, IV, '12 (D). Superintendent, White Mills of New Hampshire, West Peterboro, N. H.

Brown, Russell Lee, VI, '21 (B.T.E.). With Burlington Mills, Burlington, Vt.

Brown, Will George, Jr., IV, '22 (B.T.C.). Assistant Chemist, Lowell Bleachery, Lowell, Mass.

Buchan, Donald Cameron, II, '01 (D). Assistant Superintendent, M. T. Stevens & Sons Company, North Andover, Mass.

Burbeck, Dorothy Maria, IV, '20 (B.T.C.). Chelmsford, Mass.

Burnham, Frank Erwin, IV, '02 (D). In Charge of Laboratory of Dye Chemicals, United States Color and Chemical Company, 85 Broad Street, Boston, Mass.

Cameron, Elliott Francis, IV, '11 (D). Treasurer, Amos F. Chase Company, Inc., 28 Chauncy Street, Boston, Mass.

Campbell, Alexander, VI, '23 (B.T.E.). Draftsman, John A. Stevens, Engineer, Lowell, Mass.

Campbell, Louise Porter, IIIb, '03 (C). With Ginn & Co., 15 Ashburton Place, Boston, Mass.

Campbell, Orison Sargent, II, '03 (D). Superintendent, Canadian Consolidated Felt Company, Ltd., Kitchener, Ont.

Cannell, Philip Stuart, VI, '23 (B.T.E.). Textile Engineer, Lockwood, Greene & Co., 24 Federal Street, Boston, Mass.

Carr, George Everett, I, '05 (D). Rate Setting, Columbia Graphophone Company, Bridgeport, Conn.

Carter, Robert Albion, IV, '02 (D). Assistant Sales Manager, E. I. du Pont de Nemours & Co., 126–128 South Front Street, Philadelphia, Pa.

Cary, Julian Clinton, VI, '10 (D). Branch Manager, American Mutual Liability Insurance Company, 209 Pearl Street, Hartford, Conn.

Caya, Ferdinand Joseph, IV, '22 (B.T.C.). Textile Colorist, National Aniline and Chemical Company, Buffalo, N. Y.

Chamberlin, Frederick Ellery, I, '03 (D). Overseer of Spinning, Monument Mills, Housatonic, Mass.

Chandler, Proctor Ralph, IV, '11 (D). Manufacturer, Chandler Manufacturing Company, Weymouth, Mass.

Chang, Chi, VI, '23 (B.T.E.).

Chang, Wen Chuan, VI, '21 (B.T.E.). 58 Kiangsi Road, Shanghai, China.

Chen, Shih Ching, IV, '22 (B.T.C.). Hou Sung Cotton Mill, Shanghai, China.

Chisholm, Lester Bury, I, '11 (D). Assistant General Manager, Everlastik, Inc., Chelsea, Mass.

Church, Charles Royal, II, '06 (C).

Churchill, Charles Whittier, III, '06 (D). Manager, Churchill Manufacturing Company, Inc., Lowell, Mass.

Clapp, Frank Austin, II, '04 (D). Salesman, Dunmore Worsted Company, Inc., 215 4th Avenue, New York City.

Clark, Earl William, IV, '18 (B.T.C.). Chemist, By Pro Chemical Corporation, Niagara Falls, N. Y.

Clark, Thomas Talbot, II, '10 (D). Treasurer, Talbot Mills, North Billerica, Mass.

Clarke, George Dean, II, '21 (C). With Franklin Process Company, 564 Eddy Street, Providence, R. I.

Clayton, Harold Edmund, VI, '21 (B.T.E.). Assistant Superintendent, International Worsted Mills, Methuen, Mass.

Cleary, Charles Joseph, II, '13 (D). Chief, Textile and Rubber Branch, Engineering Division, United States Army Air Service, McCook Field, Dayton, Ohio.

Clifford, Albert Chester, VI, '22 (B.T.E.). Assistant, Research Department, The National Association of Cotton Manufacturers, 45 Milk Street, Boston, Mass.

Clogston, Raymond B., IV, '04 (D). Superintendent of Dyeing, Merrimack Manufacturing Company, Lowell, Mass.

Coan, Charles Bisbee, IV, '12 (D). Dye Demonstrator, Jennings & Co., 93 Broad Street, Boston, Mass.

Cohen, Arthur Edward, IV, '23 (B.T.C.).

Colby, James Tracy, VI, '16 (D). Salesman, F. C. Huyck & Sons, Albany, N. Y.

Cole, Edward Earle, IV, '06 (D). Reporter, Bradstreet Company, Boston, Mass.

Cole, James Thomas, II, '05 (D). Treasurer, Arlington Industries for the Blind, Arlington, Mass.

Collonan, Herbert Joseph, II, '22 (D). Assistant Designer, Beoli Mills, Fitchburg, Mass.

Coman, James Groesbeck, I, '07 (D). Manager, Tipton Cotton Mills, Covington, Tenn.

Conant, Harold Wright, I, '09 (D). Manager, Conant, Houghton & Co., Inc., Littleton, Mass.

Conant, Richard Goldsmith, I, '12 (D). Sales Executive, Brighton Mills, Passaic, N. J.

Conklin, Jennie Grace, IIIb, '05 (C).

Cook, Kenneth Bartlett, I, '13 (D). Manager, Textile Section, United States Rubber Company, 122 Adams Street, Newark, N. J.

Craig, Albert Wood, IV, '07 (D). Superintendent, Windsor Print Works, North Adams, Mass.

Craig, Clarence Eugene, III, '02 (D). Farming, Derry, N. H.

Creese, Guy Talbot, IV, '14 (D). Chemist, Creese & Cook Company, Danversport, Mass.

Culver, Ralph Farnsworth, IV, '04 (D). Vice-President and Manager, Providence Office, Ciba Company, Inc., 26 Custom House Street, Providence, R. I.

Cummings, Edward Stanton, VI, '16 (D). Cotton Tester, United States Department of Agriculture, Clemson College, S. C.

Curran, Charles Ernest, III, '02 (C). Head Designer, Wood Worsted Mills, Lawrence, Mass.

Currier, Herbert Augustus, I, '06 (D). Manager, Yarn Department, Wm. Whitman Company, Inc., 25 Madison Avenue, New York City.
Currier, John Alva, II, '01 (D). Superintendent, Pentucket Mills (M. T. Stevens & Sons Company), Haverhill, Mass.
Curtis, Frank Mitchell, I, '06 (D). Lumber Merchant, Wm. Curtis Sons Company, 30 Eustis Street, Roxbury, Mass.
Curtis, William Leavitt, II, '05 (C).
Cutler, Benjamin Winthrop, Jr., III, '04 (D).
Cuttle, James H., II, '99 (D).

Dalton, Gregory Smith, IV, '12 (D).
Davieau, Alfred Edward, VI, '16 (D). United States Testing Company, Inc., 316 Hudson Street, New York City.
Davieau, Arthur Napoleon, VI, '13 (D). Superintendent, Kenwood Mills, Ltd., Arnprior, Ont.
Davieau, Leon Arthur, VI, '23 (B.T.E.). With Pacific Mills, Lawrence, Mass.
Davis, Alexander Duncan, VI, '14 (B.T.E.). Instructor, Northeastern College, Springfield, Mass.
Dearborn, Roy S., VI, '13 (D). Purchasing Agent, Brightwood Manufacturing Company, North Andover, Mass.
Dearth, Elmer Elbridge, IV, '12 (D). Assistant to Factory Manager, The Federal Rubber Company, Cudahy, Wis.
Derby, Roland Everett, IV, '22 (B.T.C.). Dyer, Lowell Dye Works, Lowell, Mass.
de Sa, Francisco, VI, '18 (B.T.E.). Avenue da Graca, Bahia, Brazil.
Dewey, James French, II, '04 (D). Vice-President and Superintendent, A. G. Dewey Company, Quechee, Vt.
Dewey, Maurice William, II, '11 (D). Inspector of Real Estate and Real Estate Loans, National Life Insurance Company, Montpelier, Vt.
Dillon, James Henry, III, '05 (D).
Donald, Albert Edward, II, '04 (D). Agent, Hecla Mill (American Woolen Company), Uxbridge, Mass.
Doran, Wilbur Kirkland, II, '22 (D). Assistant Designer, Wuskanut Mills, Inc., Farnumsville, Mass.
Dorr, Clinton Lamont, VI, '14 (D). With Raymond Syndicate, 356 Washington Street, Boston, Mass.
Douglas, Walter Shelton, II, '21 (D). 12 Bertram Street, Lowell, Mass.
Duval, Joseph Edward, II, '10 (D). Yarn Dealer, 308 Chestnut Street, Philadelphia, Pa.
Dwight, John Francis, Jr., II, '08 (D). Proprietor, Humarock Inn, Humarock, Mass.

Echmalian, John Gregory, VI, '16 (B.T.E.). Educational Division, Cheney Brothers, South Manchester, Conn.
Ehrenfried, Jacob Benjamin, II, '07 (C). With George Ehrenfried Company, Lewiston, Me.
Elliot, Gordon Baylies, II, '12 (D). In Charge of Production, Reed & Prince Manufacturing Company, Worcester, Mass.
Ellis, Charles Albert, VI, '21 (B.T.E.). Production Manager, Lamson Company, Syracuse, N. Y.
Emerson, Frank Warren, II, '03 (D). Agent, Standish Worsted Company, Penacook, N. H.
Engstrom, Karl Emil, VI, '12 (D).
Enloe, Winfred Paige, I, '22 (D). Overseer, W. A. Handley Manufacturing Company, Roanoke, Ala.
Evans, Alfred Whitney, III, '03 (D).
Evans, William Robinson, III, '03 (D). 309 Main Street, Bradford, Mass.
Everett, Charles Arthur, IV, '19 (B.T.C.). Instructor, Dyeing Department, Lowell Textile School, Lowell, Mass.
Ewer, Nathaniel Trull, IV, '01 (D). Chemist, American Dyewood Company, Chester, Pa.

Fairbanks, Almonte Harrison, II, '09 (D). Treasurer, Middlesex Knitting Company, Wakefield, Mass.

Farmer, Chester Jefferson, IV, '07 (D). Professor of Chemistry, Northwestern Medical School, Chicago, Ill.

Farnsworth, Harold Vincent, VI, '16 (B.T.E.). Textile Engineer, Atkinson, Haserick & Co., 152 Congress Street, Boston, Mass.

Farr, Leonard Schaefar, II, '08 (D). Assistant Superintendent, No. 2 Mill, Farr Alpaca Company, Holyoke, Mass.

Farwell, Claude Chapman, VI, '23 (B.T.E.). With Jackson Mills, Nashua, N. H.

Fels, August Benedict, II, '99 (D). Manufacturer, William Fels, Inc., 148 West 23d Street, New York City.

Ferguson, Arthur Feiling, I, '03 (D). With Tariff Commission, Washington, D. C.

Ferguson, William Gladstone, III, '09 (D). Manager, Efficiency and Experimental Department, Ludlow Manufacturing Associates, Ludlow, Mass.

Finlay, Harry Francis, IV, '10 (D). Color Chemist, National Aniline and Chemical Company, Boston, Mass.

Fisher, Russell Todd, VI, '14 (D). Technical Secretary, National Association of Cotton Manufacturers, 45 Milk Street, Boston, Mass.

Fiske, Starr Hollinger, II, '09 (D). Superintendent, Wachusett Mills and E. J. Hylan Textile Company, Lowell, Mass.

Fitzgerald, John Francis, IV, '18 (B.T.C.). Dyer, Boston Dye House, Malden, Mass.

Fleischmann, Meyer, IV, '20 (B.T.C.). Chief Chemist, Real Silk Hosiery Mills, Indianapolis, Ind.

Fleming, Frank Everett, IV, '06 (D). Assistant Dyer and Finisher, Goodall Worsted Company, Sanford, Me.

Fletcher, Roland Hartwell, VI, '10 (D).

Flynn, Thomas Patrick, IV, '11 (D). Salesman, American Aniline Products, Inc., Boston, Mass.

Ford, Edgar Robinson, IV, '11 (D). Finisher, Sayles Finishing Plants, Saylesville, R. I.

Forsaith, Charles Henry, VI, '20 (B.T.E.). Superintendent, Nashua Manufacturing Company (Jackson Mills), Nashua, N. H.

Forsaith, Ralph Allen, VI, '16 (B.T.E.). Assistant Superintendent, Appleton Company, Lowell, Mass.

Forsyth, Harold Downes, VI, '23 (B.T.E.). Secretary, William Forsyth & Sons Co., Lynn, Mass.

Foster, Boutwell Hyde, VI, '17 (B.T.E.). Textile Engineer, Textile Section, United States Rubber Company, 122 Adams Street, Newark, N. J.

Foster, Clifford Eastman, II, '01 (D). Manager, Phoenix Mills, Millbury, Mass.

Frost, Harold Benjamin, II, '12 (D). Mill Superintendent, Newichawanick Company, South Berwick, Me.

Fuller, Allen Reed, IV, '17 (B.T.C.). Chemist, Bliss, Fabyan Company, Three Rivers, Mass.

Fuller, George, I, '03 (D). Associate Editor and Fabric Expert, F. P. Bennett & Co., Inc., 154 Nassau Street, New York City.

Gadsby, Arthur Norton, II, '13 (D). 17 Willow Street, North Adams, Mass.

Gahm, George Leonard, II, '06 (D). Superintendent, Yarn Department, Wood Worsted Mills, Lawrence, Mass.

Gainey, Francis William, IV, '11 (D). 1 Kingston Street, Lawrence, Mass.

Gale, Harry Laburton, III, '10 (D). Head Designer, Hunter Manufacturing and Commission Company, 58 Worth Street, New York City.

Gay, Olin Dow, II, '08 (D). Superintendent of Woolen Mill, Gay Brothers Company, Cavendish, Vt.

Gerrish, Walter, III, '03 (D). Teacher, Occupational Therapy, Devereaux Mansion, Inc., Marblehead, Mass.

Gillie, Stanley James, I, '22 (D). Knitting Department, Ipswich Mills, Gloucester Branch, Gloucester, Mass.

Gillon, Sara Agnes, IIIb, '06 (C).
Goldberg, George, VI, '10 (D). Manufacturer, Liberty Lace and Braid Company, 35 Wareham Street, Boston, Mass.
Goldman, Moses Hyman, IV, '20 (B.T.C.). Second Hand and Dye House Chemist, Friedman-Blau-Farber Company, Cleveland, Ohio.
Goller, Harold Poehlmann, II, '23 (D). Salesman, William Whitman Company, Inc., 25 Madison Ave., New York City.
Goodhue, Amy Helen, IIIb, '00 (C). See Harrison, Mrs. Arthur.
Gooding, Francis Earle, IV, '19 (B.T.C.). Night Superintendent, Chipman Chemical Engineering Company, Bound Brook, N. J.
Goosetrey, Arthur, IV, '21 (B.T.C.). With Rosemont Dyeing Company, Woonsocket, R. I.
Goosetrey, John Thomas, IV, '21 (B.T.C.). Overseer, Dyeing and Finishing, and General Chemist, Rhode Island Lace Company, West Barrington, R. I.
Gould, Norman Culver, VI, '19 (B.T.E.). Textile Engineer, F. C. Huyck & Sons, Albany, N. Y.
Greenberg, Archie, II, '21 (D). Textile Expert, Hart Schaffner & Marx, Chicago, Ill.
Gyzander, Arne Kolthoff, IV, '09 (D). Chemist, National Aniline and Chemical Company, 113 High Street, Boston, Mass.

Haddad, Nassib, VI, '23 (B.T.E.). In Planning Department, Slatersville Finishing Company, Slatersville, R. I.
Hadley, Richard Francis, IV, '22 (B.T.C.). Salesman, Carbon Coal and Coke Company, Boston, Mass.
Hadley, Walter Eastman, IV, '08 (D). Chief Chemist, The Clark Thread Company, Newark, N. J.
Hadley, Wilfred Nourse, II, '22 (D). Billerica, Mass.
Hager, Hazen Otis, II, '21 (C). Assistant Designer, M. T. Stevens & Sons Company, North Andover, Mass.
Halsell, Elam Ryan, I, '04 (C).
Hammond, Chester Twombly, II, '23 (D).
Hardie, Newton Gary, I, '23 (D). With Judson Mills, Greenville, S. C.
Hardy, Philip Lewis, VI, '10 (D). Contractor and Builder, Andover, Mass.
Harmon, Charles Francis, I, '99 (D). 86 Kingsland Avenue, Elmhurst, L. I.
Harrington, Thomas, IV, '15 (D). Superintendent, Monarch Leather Company, 1127 West Division Street, Chicago, Ill.
Harris, Charles Edward, I, '05 (D). General Manager, The Harris Company, Easthampton, Mass.
Harris, George Simmons, I, '02 (C). President and Manager, Exposition Cotton Mills, Atlanta, Ga.
Harrison, Mrs. Arthur (Goodhue, Amy Helen), IIIb, '00 (C). Dracut, Mass.
Hart, Arthur Norman, IV, '19 (B.T.C.).
Hart, Howard Roscoe, I, '23 (D). With Mohawk Carpet Company, Amsterdam, N. Y.
Haskell, Spencer Howard, II, '07 (D). 56 Grove Street, Worcester, Mass.
Haskell, Walter Frank, IV, '02 (D). Head of Dyeing Department, Dana Warp Mills, Westbrook, Me.
Hassett, Paul Joseph, IV, '12 (D). Assistant Factory Manager, Bridgeport Works, Remington Typewriter Company, Bridgeport, Conn.
Hathorn, George Wilmer, IV, '07 (D). Chemist, Lawrence Gas Company, Lawrence, Mass.
Hay, Ernest Crawford, II, '11 (D). Superintendent, Monomac Spinning Company, Lawrence, Mass.
Hendrickson, Walter Alexander, II, '11 (D). With National Knitting Company, 905 Clinton Street, Milwaukee, Wis.
Hennigan, Arthur Joseph, II, '06 (D). President, Seneca Manufacturing Company, and New England Representative, Cox & Schreiber, of New York, 31 Bedford Street, Boston, Mass.
Hildreth, Harold William, II, '07 (D). Granite Dealer, Westford, Mass.
Hillman, Ralph Greeley, VI, '22 (B.T.E.). Salesman, Samson Cordage Works, Boston, Mass.

Hintze, Thomas Forsyth, I, '06 (C). 216 East 20th Street, Tulsa, Okla.

Hodge, Harold Bradley, VI, '22 (B.T.E.). With J. C. and W. T. Monahan, Civil Engineers and Surveyors, 430 Hildreth Building, Lowell, Mass.

Hoffman, Richard Robert, II, '21 (C). Assistant Designer, Beoli Mills, Fitchburg, Mass.

Holden, Francis Crawford, IV, '09 (D). Chemist and Dyer, Chelsea Fiber Mills, 1155 Manhattan Avenue, Brooklyn, N. Y.

Holden, John Sanford, II, '20 (D). Manufacturer, Automatic Machine Products' Company, Attleboro, Mass.

Holgate, Benjamin, III, '02 (C). Agent, Boott Mills, Lowell, Mass.

Hollings, James Louis, I, '05 (D). Buyer and Converter (Cotton Goods), W. R. Grace & Co., 7 Hanover Square, New York City.

Holmes, Otis Milton, VI, '13 (B.T.E.). Draftsman, United Shoe Machinery Corporation, Beverly, Mass.

Hood, Leslie Newton, IV, '12 (D). Chemist, Cheney Brothers, South Manchester, Conn.

Hook, Russell Weeks, IV, '05 (D). Chemist in charge of Textile Department, Arthur D. Little, Inc., 30 Charles River Road, Cambridge, Mass.

Horsfall, George Gordon, II, '04 (C). Assistant Dyer, Interwoven Mills, Inc., Martinsburg, W. Va.

Horton, Chester Temple, VI, '14 (B.T.E.). Wilmington, Mass.

Houghton, Robert Kingsbury, IV, '23 (B.T.C.). Assistant Chemist, Bradford Dyeing Association, Bradford, R. I.

Howarth, Charles Lincoln, IV, '17 (B.T.C.). Assistant Professor of Dyeing, Lowell Textile School, Lowell, Mass.

Howe, Woodbury Kendall, I, '10 (D). Assistant Superintendent, Merrimack Manufacturing Company, Lowell, Mass.

Hoyt, Charles William Henry, IV, '07 (D).

Hsu, Hsueh-Chang, VI, '23 (B.T.E.).

Hubbard, Harold Harper, I, '22 (D). Second Hand, Hamilton Manufacturing Company, Lowell, Mass.

Hubbard, Ralph King, IV, '11 (D). Treasurer and Manager, Packard Mills, Inc., Webster, Mass.

Huising, Geronimo Huerva, I, '08 (D). Sugar Cane Planter, San Agustin Plantation Company, Inc., San José, Mindoro, P. I.

Hunt, Chester Lansing, III, '05 (C).

Hunton, John Horace, II, '11 (D). Treasurer and General Manager, Newichawanick Company, South Berwick, Me.

Hurtado, Leopoldo, Jr., VI, '10 (D). General Manager, Hurtado & Co., Uruapan, Michoacan, Mex.

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Hutton, Clarence, III, '03 (C). Editor, "Textile World," 111 Summer Street, Boston, Mass.

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Jelleme, William Oscar, I, '10 (D). Technical Superintendent, Brighton Mills, Passaic, N. J.

Jen, Shang Wu, I, '21 (D).

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Johnson, Arthur Kimball, IV, '13 (D) (B.S. 1917, Massachusetts Institute of Technology). Instructor in Chemistry, Lowell Textile School, Lowell, Mass.

Johnson, George Henry, IV, '20 (B.T.C.). Director of Research, Laundry Fellowship, Mellon Institute, University of Pittsburgh, Pittsburgh, Pa.

Jones, Everett Amos, III, '05 (D). Superintendent and Secretary, Nye & Wait Kilmarnock Corporation, Auburn, N. Y.

Jones, Nathaniel Erskine, I, '21 (D). Overseer, Renfrew Manufacturing Company, Adams, Mass.

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Keough, Wesley Lincoln, II, '10 (D). 850 North Raymond Avenue, Pasadena, Calif.

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Lamb, Arthur Franklin, II, '10 (D). In business, cleansing and dyeing, Rockland, Me.

Lamont, Robert Laurence, II, '12 (D).

Lamprey, Leslie Balch, IV, '16 (B.T.D.). 173 Parker Street, Lawrence, Mass.

Lamson, George Francis, I, '00 (D). With Ludlow Manufacturing Associates, Ludlow, Mass.

Lane, John William, I, '06 (C).

Lane, Oliver Fellows, IV, '15 (B.T.D.). Chemist, Head of Color Making Department, Lowe Paper Company, Ridgefield, N. J.

Larratt, John Francis, II, '22 (D). Billerica, Mass.

Laughlin, James Knowlton, III, '09 (D).

Laurin, Eric Thursten Lawrence, IV, '21 (B.T.C.). Chemist, Sayles Finishing Plant, Saylesville, R. I.

Laurin, Sven Albert, IV, '23 (B.T.C.). Assistant Colorist, Fiberloid Corporation, Indian Orchard, Mass.

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Lombard, Carleton Joshua, VI, '23 (B.T.E.). Erector, Curtis & Marble Machine Company, Worcester, Mass.

Loney, Robert William, II, '22 (D). Foreman, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.

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Marshall, Chester Stanley, II, '22 (D). With Wood Mill, Lawrence, Mass.

Martin, Harry Warren, IV, '11 (D). Divisional Manager, Hood Rubber Company, Watertown, Mass.

Mason, Archibald Lee, VI, '09 (D).

Mather, Harold Thomas, VI, '13 (D). Salesman, John V. Farwell Company of New York, 99 Chauncy Street, Boston, Mass.

Mathieu, Alfred Jules, II, '20 (D). Superintendent of Combing, French Worsted Company, Woonsocket, R. I.

Matthews, Elmer Clark, II, '17 (D). Superintendent, Thermo Mills, Inc., West Sand Lake, N. Y.

Mauersberger, Herbert Richard Carl, III, '18 (D). Instructor and Lecturer in Textiles, Textile Shop, No. 12 School, Passaic, N. J.

Meadows, William Ransom, I, '04 (D). In charge of Division of Cotton Marketing, Bureau of Agricultural Economics, Department of Agriculture, Washington, D. C.

Meek, Lotta, IIIb, '07 (C). See Parker, Mrs. Herbert L.

Merchant, Edith Clara, IIIb, '00 (C). Drawing Supervisor, Lowell, Mass.

Merrill, Allan Blanchard, IV, '11 (D). Development Engineer, B. F. Goodrich Rubber Company, Akron, Ohio.

Merrill, Gilbert Roscoe, VI, '19 (B.T.E.). Instructor, Cotton Yarns and Knitting, Lowell Textile School, Lowell, Mass.

Midwood, Arnold Joseph, IV, '05 (D). Salesman, I. Levinstein & Co., 281 Franklin Street, Boston, Mass.

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Molloy, Francis Henry, II, '16 (D). Assistant Designer, Assabet Mill (American Woolen Company), Maynard, Mass.

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Moore, William Joseph, IV, '21 (B.T.C.). Chemist, Pacific Mills, Lawrence, Mass.

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Morris, Merrill George, IV, '21 (B.T.C.). Assistant Dyer, Felters Company, Inc., Millbury, Mass.

Mullaney, John Francis, VI, '20 (B.T.E.). With Saco-Lowell Shops, Lowell, Mass.

Mullen, Arthur Thomas, II, '09 (D). Designer and Assistant Superintendent, Mayo Woolen Mills Company, Millbury, Mass.

Munroe, Sydney Philip, I, '12 (D). Manager, Ralph E. Loper & Co., 100 Purchase Street, Fall River, Mass.

Murray, James, IV, '13 (D). Salesman, Appleton Coated Paper Company, Appleton, Wis.

Murray, James Andrew, II, '10 (D). With H. P. Murray Company, Inc., 224 Commercial Street, Boston, Mass.

Najar, G. George, IV, '03 (D). Overseer of Dyeing, Monument Mills, Housatonic, Mass.

Nary, James Anthony, II, '22 (D). Assistant Fabric Expert, United States Testing Company, New York City.

Nelson, Roy Clayton, II, '21 (C). Designer, Assabet Mills, Maynard, Mass.

Nelson, Russell Sprague, VI, '22 (B.T.E.). With Pacific Mills, Lawrence, Mass.

Neugroschl, Sigmond Israel, I, '21 (D).

Newall, John Douglas, IV, '09 (D). Division Superintendent, Arnold Print Works, North Adams, Mass.

Newcomb, Guy Houghton, IV, '06 (C). Assistant Manager, Dyestuff Department, E. I. du Pont de Nemours & Co., 1114 Tribune Building, Chicago, Ill.

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Nichols, Raymond Elmore, VI, '10 (D). Office Manager, Lowell Bleachery, Lowell, Mass.

Niven, Robert Scott, VI, '12 (D). Draftsman, General Electric Company, Lynn, Mass.

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O'Connor, Lawrence Dennis, VI, '17 (D). With Beggs & Cobb, Winchester, Mass.

O'Donnell, John Delaney, I, '04 (C).

O'Hara, William Francis, IV, '04 (C).

Orr, Andrew Stewart, IV, '22 (B.T.C.). With Cherry & Webb, Lowell, Mass.

Othote, Louis Joseph, I, '23 (D). With B. B. & R. Knight (Arctic Mills), Arctic, R. I.

Palais, Samuel, IV, '18 (B.T.C.). Overseer, Bleaching and Dyeing, Peerless Knitting Mills Company, Barre, Vt.

Parker, Everett Nichols, I, '05 (D). Parker Spool and Bobbin Company, 27–53 Middle Street, Lewiston, Me.

Parker, Harry Carmi, III, '00 (C). 144 Berkeley Street, Boston, Mass.

Parker, Mrs. Herbert L. (Meek, Lotta L.), IIIb, '07 (C). 4 Brookside Circle, Auburn, Me.

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Peabody, Roger Merrill, II, '16 (D). Textile Superintendent, Industrial Fiber Company, Cleveland, Ohio.

Pearson, Alfred Henry, IV, '11 (D). Salesman, Ciba Company, Inc., 93 Broad Street, Boston, Mass.

Pease, Chester Chapin, I, '09 (D). Superintendent, Columbian Manufacturing Company, Greenville, N. H.

Peck, Carroll Wilmot, IV, '13 (D). Salesman, George Mann & Co., Inc., 251 Tockwotton Street, Providence, R. I.

Pensel, George Robert, IV, '13 (B.T.D.). Vice-President, Ritter Chemical Company, Amsterdam, N. Y.

Perkins, John Edward, III, '00 (D). Woolen Mill Superintendent, S. N. & C. Russell Manufacturing Company, Pittsfield, Mass.

Perkins, Joshua Dean, III, '08 (D). Overseer, Amoskeag Manufacturing Company, Manchester, N. H.

Perlman, Samuel, IV, '17 (B.T.C.).

Perlmuter, Barney Harold, IV, '23 (B.T.C.). Credit Manager, American Furniture Company, Boston, Mass.

Petty, George Edward, I, '03 (C). 211 South Ashe Street, Greensboro, N. C.

Phaneuf, Maurice Philippe, III, '20 (D). Assistant Styler, Guerin Mills, Inc. (Montrose Worsted Company), Woonsocket, R. I.

Pillsbury, Ray Charles, I, '13 (D). Superintendent of Weaving, Cheney Brothers, South Manchester, Conn.

Plaisted, Webster E., II, '18 (D). Superintendent, American Woolen Company, Rochdale, Mass.

Potter, Carl Howard, I, '09 (D). With Frank W. Van Ness, Industrial Engineer, Passaic, N. J.

Pottinger, James Gilbert, II, '12 (D). Agent and Grey Goods Buyer, S. Slater & Sons, Inc., 45 East 17th Street, New York City.

Powers, Walter Wellington, IV, '20 (B.T.C.). Instructor, Concord High School, Concord, N. H.

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Prescott, Walker Flanders, IV, '09 (D). Dyes and Chemicals, Prescott & Co., 323 Craig Street, West, Montreal, Can.

Prince, Sylvanus Cushing, VI, '08 (D).

Proctor, Braman, IV, '08 (D). Demonstrator of Dyestuffs, Kuttroff, Pickhardt & Co., Inc., 86 Federal Street, Boston, Mass.

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Putnam, Leverett Nelson, IV, '10 (D). Overseer of Dyeing, Arlington Mills, Lawrence, Mass.

Putnam, Philip Clayton, IV, '13 (D). Dyer, Apponaug Finishing Company, Apponaug, R. I.

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Radford, Garland, II, '20 (D). Manufacturer, Oriental Textile Mills, Houston, Tex.

Ramsdell, Theodore Ellis, I, '02 (D). Cotton Manufacturer, Monument Mills, Housatonic, Mass.

Raymond, Charles Abel, IV, '07 (D). Assistant Superintendent, New England Fuel and Transportation Company, Everett, Mass.

Reed, Norman Bagnell, I, '10 (D). General Superintendent, Lawrence Manufacturing Company, Lowell, Mass.

Reynolds, Fred Bartlett, II, '08 (D). Purchasing Agent, M. T. Stevens & Sons Company, North Andover, Mass.

Reynolds, Isabel Halliday, III, '03 (C). Clerk, Pacific Mills Print Works, Lawrence, Mass.

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Rich, Edward, IV, '15 (B.T.D.). President, Jackson Caldwell Company, East Boston, Mass.

Rich, Everett Blaine, III, '11 (D). Managing Director, C. H. Greenleaf Company, Hotel Vendome, Boston, Mass., and Treasurer, Wolfeboro Mills, Wolfeboro, N. H.

Rich, Milton Scott, II, '22 (D). With Riverina Mills, Medford Hillside, Mass.

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Riggs, Homer Chase, VI, '17 (B.T.E.). Sales Engineer, Textile Machinery Department, Rodney Hunt Machine Company, Orange, Mass.

Ripley, George Keyes, II, '17 (D). Superintendent, Troy Blanket Mills, Troy, N. H.

Roberson, Pat Howell, I, '05 (C). Merchant, James R. Roberson & Sons, Cropwell, Ala.

Roberts, Carrie Isabel, IIIb, '05 (C). Craft Work, 37 Grace Street, Lowell, Mass.

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Robinson, William Carleton, III, '03 (C). With American Wool and Cotton Reporter, 530 Atlantic Avenue, Boston, Mass.

Robson, Frederick William Charles, IV, '10 (D).

Roche, Raymond Vincent, IV, '12 (D). With National Aniline and Chemical Company, Buffalo, N. Y.

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Scott, Gordon Maxwell, IV, '20 (B.T.C.). Chemist, Holden-Leonard Company, Bennington, Vt.

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Shea, Francis James, II, '12 (D). Clerk, Corticelli Silk Company, Florence, Mass.

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Spiegel, Edward, II, '03 (C). Theatrical Business, New York City.

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Stone, Ira Aaron, IV, '09 (D). Vice-President, Royal Manufacturing Company, Boston, Mass.

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Sullivan, Lambert William, II, '23 (D).

Sullivan, Willard David, II, '23 (D). With Pacific Print Works, Lawrence, Mass.

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Sutton, Leslie Emans, I, '17 (D). Superintendent, Anniston Cordage Company, Boston, Mass.

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Swift, Edward Spooner, S. J., I, '02 (D). Clergyman, Xavier High School, College of St. Francis Xavier, New York City.

Sylvain, Charles Emile, VI, '13 (D). With International Machinery Company of 104 Pearl Street, New York City, at Rua Sao Bento, 30, Rio de Janeiro, Brazil.

Syme, James Francis, II, '00 (D). Vice President and General Manager, Southern Worsted Corporation, Greenville, S. C.

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Walker, Anna Gertrude, IIIb, '03 (C). See Pradel, Mrs. Alois J.

Walker, Raymond Scott, II, '23 (D). In charge of Planning and Efficiency Department, Chelsea Fibre Mills, Brooklyn, N. Y.

Wang, Chen, IV, '23 (B.T.C.).

Wang, Cho, VI, '23 (B.T.E.).

Wang, Tung Chuan, VI, '23 (B.T.E.).

Wang, Yung Chi, II, '21 (D).

Warren, Philip Hamilton, II, '05 (D). Superintendent, Hopeville Manufacturing Company, Worcester, Mass.

Washburn, John Milton, Jr., IV, '21 (B.T.C.). Salesman and Demonstrator, National Aniline and Chemical Company, Inc., 113 High Street, Boston, Mass.

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Wheelock, Stanley Herbert, II, '05 (D). Treasurer, Stanley Woolen Company, Uxbridge, Mass.

Whitcomb, Roscoe Myron, IV, '10 (D). Pharmacist, R. M. Whitcomb, Ashland, N. H.

White, Royal Phillip, II, '04 (D). Agent, Stirling Mills and Belvidere Woolen Company, Lowell, Mass.

Whitehill, Warren Hall, IV, '12 (D). Chemist, Brightwood Manufacturing Company, North Andover, Mass.

Wightman, William Henry, IV, '06 (D). Salesman, Ciba Company, Inc., 93 Broad Street, Boston, Mass.

Williamson, Douglas Franklin, I, '22 (D). Overseer, American Net and Twine Company, Blue Mountain, Ala.

Wing, Charles True, III, '02 (D). Designer, Merrimack Woolen Corporation, Dracut, Mass.

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Wood, Ernest Hadley, S.B., IV, '11 (D).

Wood, Herbert Charles, I, '06 (D). Assistant Superintendent, Union Wadding Company, Pawtucket, R. I.

Wood, James Carleton, IV, '09 (D). Travelling Representative, Atlantic Dyestuff Company, Boston, Mass.

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Woodies, Ida Alberta, IIIb, '00 (C). See Shananquet, Mrs. Lee.

Woodman, Harry Lincoln, I, '02 (C). Engineer, Saco-Lowell Shops, Lowell, Mass.

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Wright, Edward, II, '05 (C). Assistant Engineer, State Department of Health, 141 State House, Boston, Mass.

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Publication of this Document approved by the Commission on Administration and Finance.

SERIES 27, No. 4

May, 1924

BULLETIN

OF THE

Lowell Textile School

LOWELL, MASS.

Issued Quarterly

1924-1925

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under Act of Congress of July 16, 1894
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Moody Street and Colonial Avenue

Publication of this Document
approved by the
Commission on Administration and Finance

SOME EXPERIMENTS IN THE USE OF LONG DRAFTS IN SPINNING.

A general interest among the manufacturers of cotton yarn in the feasibility of using more than the conventional amount of draft in spinning led some of the members of the class of 1924 to attempt an experiment along that line as their thesis project.

The following abstract from the thesis of J. A. Miller and S. F. Toupin tells of an experiment calculated to show what would result from the application of an extremely long draft in one operation such as spinning.

No claim for originality is made as the method consisted simply of mounting a second set of three lines of drawing rolls behind the regular rolls on the frame. The additional rolls were set at a suitable height and angle and geared to give drafts such as are commonly applied in commercial practice.

The design of roll stands, which kept the third and fourth rolls in the set some distance apart, made it necessary to eliminate any draft at that point so there were in use what amounted to five lines of drawing rolls instead of six lines.

In order to measure the result of such a method of drawing a final comparison was made between two yarns of the same size, both of which were made from the same .50 hank slubber roving.

One of these yarns was No. 15.17 and was spun in the usual manner using drafts commonly applied in roving and spinning operations; while the other yarn was spun in one operation directly from .50 hank roving to No. 16.07 yarn. The tabulation following will show the drafting plan that was used.

Drafting Plan.

2) .50	hank slubber roving	2).50	hank slubber roving
.25	hank entering spinning frame	.25	hank entering intermediate frame
		5.2	intermediate draft
64.30	Draft applied by special arrangement of rolls in spinning operation.	2)1.30	hank intermediate roving
		.65	hank entering fine frame
		5.4	draft fine frame
		2)3.50	hank fine roving
		1.75	hank entering spinning frame
		8.66	spinning draft
16.07	yarn	15.17	yarn

After spinning, these yarns were kept together under the same atmospheric conditions so that testing was carried on in such a manner as to make the following comparisons reasonably fair and accurate.

The figures representing the strength and number of yarn are the average of 25 determinations and the twist per inch is the average of 10 separate tests.

The final item in the table following shows what per cent of the strength of the normally spun yarn was attained by the yarn spun with the abnormally long draft.

Table of Comparisons.

	Long Draft.	Short Drafts.
Strength per lea in lbs.	93.32	104.20
Number of yarn	16.07	15.17
Twist per inch	17.04	19.10
Strength constant	1,499.65	1,580.71
Per cent of strength of normal yarn	94.80	100.00

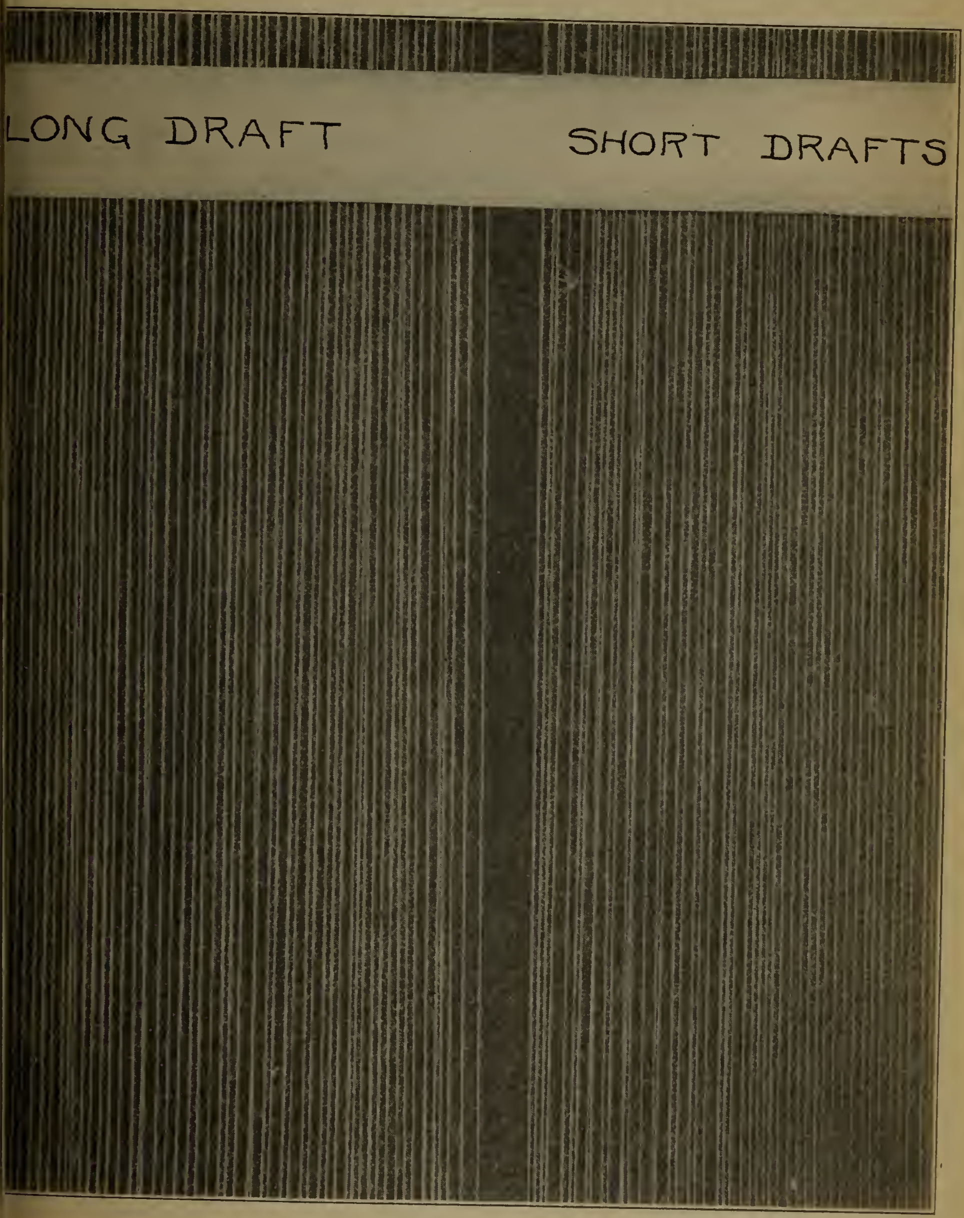
Experience gained during this experiment shows that, if long drafts are to be attempted in such an operation as spinning, the problem must be further studied for the purpose of: —

(1) Reducing the amount of clearer waste: —

(2) Preventing the stock from spreading over so much of the surface of the front roll: —

(3) Reducing the amount of projecting fiber on the yarn.

For still further comparison samples of these yarns were wound upon black card-board and photographed to show the relative degree of uniformity attained. A reproduction of one of these cards is shown herewith.



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SERIES 28, No. 1 August, 1924

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CALENDAR.

1924.

October 2, Thursday	Registration.
October 9, Thursday	Registration.
October 14, Tuesday	Opening of evening school.
November 27, Thursday; November 28, Friday	Thanksgiving recess. No classes.
December 23, Tuesday	End of first term.

1925.

January 5, Monday	Opening of second term.
March 13, Friday	Closing of evening school.
April 8, Wednesday	Graduation.

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Henry Earl McGowan . . . . 36 Varney Street.
Evening Instructor in Mathematics.
Harold Edmund Clayton, B.T.E. . . . . 37 Hardy Street, Methuen.
Evening Instructor in Mathematics.
Carlyle Darracott Fiske S.B. . . . . . . 40 Lawrence Street, Lawrence.
Evening Instructor in Worsted Yarns.
William George Stainton . . . . Bradford, Mass.
Evening Instructor in Design.

THE LOWELL TEXTILE SCHOOL

EVENING CLASSES

GENERAL INFORMATION.

Entrance Requirements.

All applicants to the evening classes must understand the English language and simple arithmetic. Those who are graduates of a grammar or high school are admitted upon certificate. Those who cannot present such a certificate are required to take examination in the subjects of English and arithmetic. In the examination in English a short composition must be written on a given theme, and a certain amount must be written from dictation. In the examination in arithmetic the applicant must show suitable proficiency in addition, subtraction, multiplication, division, common and decimal fractions, percentage, ratio and proportion. Opportunity to register or to take these examinations is offered each year, generally on the Thursday evenings of the two weeks previous to the opening of the evening school.

Registration.

Before entering the class a student must fill out an attendance card, which can be obtained at the office or from the instructors in the various departments.

Any student who has filed an attendance card and who wishes to change his course must notify the office before making the change.

Sessions.

The evening classes commence the second Monday of Octobei and continue for twenty-one weeks. The school is open on four evenings each week during the period mentioned, except when the school is closed for holiday recesses.

Supplies.

Students must provide their own books, stationery, tools, etc., and pay for any breakage or damage that they cause.

Student's supplies will be sold from the storeroom every evening school night from 6.45 to 7.15 P.M.

Fees and Deposits.

All evening courses are free to residents of Lowell. To those outside of Lowell the fee is $10 per year for *each course of two nights per week.* Students taking two courses or attending courses requiring more than two nights per week are required to pay $15 per year for three nights and $20 for four nights.

All fees and deposits must be paid in advance.

All students, whether from Lowell or not, taking Course (*a*), Chemistry and Dyeing Department, are required to make a deposit at the commencement of the course, — $5 for first-year students, and $10 for second-year students. A deposit of $10 will be required of all students taking Course (*b*), (*c*) *or* (*d*). This is to cover the cost of laboratory breakages, chemicals, apparatus, etc., and at the end of the year any unexpended balance is returned, or an extra charge made for the excess breakage.

Every student who takes the chemistry and dyeing course must check up his desk with the instructor of that department when he leaves the school. Any student not doing so will be charged 50 cents.

All students taking Machine-shop Practice will be required to make a deposit of $5. Any unexpended balance remaining at the end of the year will be returned to the student.

Report of Standing.

A report of standing covering the year's work is sent to all students who attend the entire year and take the necessary examinations.

Certificates.

The courses of the evening school are varied and arranged to meet the special needs of those engaged in the industry. They vary in length from one to four years, and at the completion of each course the certificate of the school is awarded, provided, however, that the student has been in attendance in the course during the year for which the certificate is granted.

GENERAL EVENING COURSES.

The Lowell Textile School now offers to students several general courses. For each course a definite schedule is arranged which requires attendance of from six to eight hours per week.

The object of these courses is to give young men of ambition an opportunity to obtain instruction in all the branches of science that are allied with their daily work. For example, one who is employed as a weaver in a textile mill may, by means of the courses in manufacturing, obtain knowledge of the manufacture of yarn, the production of a design, and the methods of finishing a fabric, as well as the manner of its weaving or knitting. In like manner the dyer may augment his knowledge of the chemicals and materials he is daily handling. The engineer and machinist may acquire a knowledge of the mathematics, science of mechanics, electricity and drawing that underlie all the work of an engineer.

It is recognized that the interests of such students lie in a particular field of industry, and these courses are designed to bear directly upon the special line, and supplement, as far as possible, the practical work in which the student is engaged during the day.

The student selects his course upon entrance, and continues a regular schedule of subjects for three, four or five years, as may be necessary for its completion.

In a word, any man having a common school education and the ambition to advance in his line may now secure a broad and comprehensive training in the subjects which will be of vital importance to him in obtaining the goal of his ideal.

These general courses are supplemented by partial courses in all the subjects given, so that a student who finds it impracticable to carry on all the subjects in a complete course may select and take such subjects as will be of most value to him in his work.

A student taking one of these courses may attend school during the periods in which the subjects which he selects are being given.

A description of all courses follows.

COTTON DEPARTMENT.

I. Cotton Manufacturing — 4 Years.

The Cotton Manufacturing course is designed to give a student a broad knowledge of the manufacture of cotton cloth. To do this he is required to spend three years in the department of cotton yarns, studying cotton and its conversion into yarn. A student taking this course also spends two years in weaving, one on plain and one on dobby weaving. Three years are spent in a study of the art of designing a fabric and the analysis of fabric already constructed. One year is spent in a study of the processes involved in finishing cotton fabrics. For detailed description, see subjects under Yarns, Weaving, Designing and Finishing.

Ia. Cotton Yarns — 3 Years.

The first year's work in cotton yarn manufacture consists of a study of cotton and its preparation for market, followed by a study of picking, carding and combing.

The work in the picking, carding and combing classes consists of lectures on these operations combined with problems that are peculiar to each operation such as the drafts used and the production of each process as well as the amounts of waste made. Special consideration is given to the adjustment and care of these machines and some laboratory demonstration is used to show the manner of adjusting machines for the purpose of controlling the weight of the product, the amount of work done in a day and the control of waste.

The second year's work includes a study of the drawing and roving processes and the calculations that accompany these operations. It consists also of lectures on the machines and demonstration of their adjustment, showing roll setting, draft and twist control, builder adjustment, spacing coils on the bobbin, and tension control.

During the third year the time is devoted to a study of ring and mule spinning and twisting, and as in previous years, the work consists of lectures and demonstration on the machines. During this year there is also some work done on the combing machine, particularly in the nature of its adjustment. In addition to these subjects, there is some work done in the way of planning the organization of a cotton mill with a view to showing drafts, speeds, productions and number of machines of each kind necessary for the production of a given amount of a certain yarn.

II. Wool Manufacturing — 4 Years.

In the branch of yarn manufacture the student must elect either worsted yarns or woolen yarns. In other respects the course is the same.

During the first year, courses are given in wool fibres and the preliminary processes of their conversion into yarns, calculations of the mechanism of the machines and elementary instruction in cloth designing and analysis.

During the second year, students selecting the woolen yarn option follow a course in carding and mule spinning and continue the first-year work in design and cloth analysis. Those selecting the worsted yarn option do likewise, excepting that their course in yarn instruction is on the worsted systems.

In the third year, students of the woolen yarn option finish their instruction in yarn manufacture and add to the course of design and cloth analysis a course in weaving. Students of the worsted yarn option add the same course in weaving and continue the second-year courses of worsted yarn and designing and cloth analysis.

The fourth-year courses consist of weaving, finishing, and designing.

This course is arranged to give those engaged in the manufacture of woolens and worsteds instruction in the various branches of the work. It embraces a study of wools and allied fibers and the manner of manipulating from fibers to finished fabric, including all the processes of yarn manufacturing, weaving, designing and finishing.

For detailed description of subjects see page 10.

IIa. Woolen Yarns — 2 Years.

This course is offered for students who wish instruction in woolen yarn manufacture and consists of a lecture course during the first year on the various kinds of wool fibres, trade terms, sorting, scouring, carbonizing, etc., also of a course on carding. The second year continues the instruction on carding and then takes up a course on the mule and woolen yarn spinning.

IIb. Worsted Yarns — 3 Years.

For those who desire instruction in the manufacture of worsted yarns this course is offered. The first-year work consists of a lecture course on the various kinds of wool fibres, trade terms, sorting, scouring, carbonizing, etc., also a course in carding and the calculations involved in the mechanism of the machines. The second year's course covers gilling and combing and the processes of top making. The third year is devoted to detail study of the English and French systems of worsted yarn manufacture.

For detailed description of subjects see page 10.

DESIGN DEPARTMENT.

IIIa. Cotton Design — 3 Years.

For those who wish to devote intensive study to the designing of cotton fabrics this course of designing and cloth analysis is offered. Instruction is given in the design and analysis of the standard fabrics and as many of the fancy designs and weaves as the time will permit.

IIIb. Woolen and Worsted Design — 3 Years.

This course covers the design and analysis of standard woolen and worsted fabrics and is intended for those who wish to specialize in this branch of textile fabric manufacture. Special and fancy fabrics are studied to the extent that time will permit.

For detailed description of subjects see page 11.

Va. Cotton Weaving — 1 Year.

Vb. Woolen and Worsted Weaving — 2 Years.

Vc. Dobby and Jacquard Weaving — 1 Year.

These are called weaving courses, but in reality they might more properly be called courses in loom fixing, for particular attention is given to the mechanism of the looms, the timing of the various parts, and the adjustments possible to produce desired results. Here, again, is an opportunity for students to fix, dismantle, erect and adjust looms in a way that could not be tolerated in any mill. Frequently students come to the classes with the knowledge that certain adjustments must be made upon a loom if certain results are to be obtained, but the reason for these is not known. The school offers the machine, time and instructor in order that the weaver or loomfixer may determine for himself the reason for some rule which he practices in his daily work. Not only can he become more familiar with the loom upon which he works every day, but he can study the operations of many other makes of looms.

For detailed description of subjects see page 12.

IIIc. Freehand Drawing — 3 Years.

In the course in freehand drawing, instruction is given in the drawing from models, casts and designs. Work is taken up in charcoal and also in colors. This course has appealed to many young women of the city, and it is believed that this is a most fortunate opportunity for both young women and young men of Lowell to acquire the elements of artistic designing.

CHEMISTRY AND DYEING DEPARTMENT.

Hardly any branch of applied science plays so important a part in our industrial world as chemistry. Many large mills employ the chemist as well as the dyer, and with the great progress which is being made in the manufacture and application of dyestuffs, a basic knowledge of chemistry becomes an absolute necessity to the dyer. Within a comparatively short distance from Lowell are establishments employing men who require some knowledge of chemistry but who may not necessarily use dyes. Some find a knowledge of analytical chemistry helpful in their everyday work.

To meet these varying needs of our industrial community, the school offers a two-year course in general chemistry, organic and inorganic, which may be followed by any one of three courses, viz., textile chemistry and dyeing, analytical chemistry, and textile and analytical chemistry. In order to take Courses IVb, IVc or IVd, candidates must have a certificate from Course IVa, or show by examination or approved credentials that they have taken the equivalent of the work covered by this course.

For detailed description of subjects see page 12.

IVa. Elementary Chemistry — 2 Years.

General Chemistry, including Inorganic and Organic.
Qualitative Analysis.

One lecture and one Laboratory Period per week in General Chemistry the first year, continued three nights a week during the second year, when the Elementary Organic Chemistry and Qualitative Analysis is completed.

IVb. Textile Chemistry and Dyeing — 3 Years.

Lectures in Textile Chemistry and Dyeing.
Laboratory Work in Dyeing.
Covered by 40 lectures and two nights of laboratory work per week.

IVc. Analytical Chemistry — 3 Years.

Laboratory Work and Lectures in Quantitative Analysis.
Three nights per week of class-room and laboratory work.

IVd. Textile and Analytical Chemistry — 4 Years.

Lectures in Textile Chemistry and Dyeing.
Laboratory Work in Analytical Chemistry.
Combines all lectures in Textile Chemistry and Dyeing with work of Course IVc, but does not include any Dyeing Laboratory. Three nights per week.

TEXTILE ENGINEERING DEPARTMENT

VIa. Engineering Course — 3 Years.

This course has been arranged with the object of offering to those engaged in the mechanical and electrical departments of our mills opportunities to learn something concerning the theory underlying the many practical methods which they pursue during the day.

The course in the first year is laid out to include the fundamental subjects upon which all engineering rests — mathematics, mechanics and mechanism of machines, and mechanical drawing. This elementary work is then strengthened by an additional year of mathematics and by two more years of drawing. Strength of materials is included in the second year, while the major portion of the third year's work is devoted to a consideration of the elements of steam and electrical engineering.

For detailed description of subjects see page 14.

VIb. Mechanical Drawing Course — 3 Years.

For one having occasion to make a sketch or detail drawing for the purposes of illustration or instruction, or for one who is daily required to work from a drawing or blue print, the course in mechanical drawing is offered. It first lays a foundation of the principles of mechanical drawing, and follows this with two years' work in drawing directly from parts of machines, preparing both the detail and the assembly drawing.

For detailed description of subjects see page 15.

VId. Machine Shop Course — 3 Years.

The first year of this course is spent upon subjects which will prepare the student to more readily assimilate and appreciate the real work in the shop itself. Hence a large part of the first year's work is devoted to the mechanics and mechanism of machines, so that the student will be familiar with the principles used in transmitting force and motion in the machine tools upon which he spends most of his time during his second and third years. Since the ability to read and interpret a drawing is an elementary requirement of every machinist, it is required that a portion of each of the three years be devoted to that subject.

Thus it becomes possible for one who may be working at the bench during the day to learn how to operate a lathe or other tool, or for a lathe hand to acquire a knowledge of a planer, shaper, milling machine, grinder, etc. A man who has a knowledge of the special machine which he operates may by means of this course become a more intelligent machinist. He should supplement this course with the courses in mechanical drawing and mechanism, in order that his training for an all-round machinist or mechanic may be more complete.

For detailed description of subject see page 15.

VIe. Electrical Engineering Course — 3 Years.

This course is planned to cover the fundamentals of both direct and alternating current electricity. It requires for its completion three years, three evenings per week, and the student enrolling in this course must be prepared to spend from four to six hours per week in home study and preparation. The lectures on electrical theory are supplemented by laboratory work, and the drawing in the second year is intended to familiarize the student with electrical

wiring and diagrams. In order to be admitted to this course the student must have completed the amount of mathematics described under Mathematics — First Year, on Page 15.

VIf. Direct Current Electricity — 2 Years.

The work of this course comprises the first two years of Course VIe for the satisfactory completion of which a certificate will be awarded.

FINISHING DEPARTMENT.

VIIa. Cotton Finishing — 1 Year.

VIIb. Woolen and Worsted Finishing — 1 Year.

In these courses machine work is supplemented by lectures and discussions pertaining to the many finishes given to fabrics. The action of soaps, water, steam, heat and cold upon cloth containing one fiber or combinations of fibers as used in commercial fabrics is carefully studied. These courses also help the finisher to broaden his knowledge of textile fabrics.

For detailed description of subjects see page 15.

SUBJECTS OF INSTRUCTION.

COTTON DEPARTMENT.

Cotton Yarns.

Instruction is given by means of lecture and demonstration. The outline of the course is as follows:—

Fiber. — Before taking up the details of the operation of manipulating the fiber into yarn, a careful study is made of the characteristics and classification, both botanically and commercially, of the many varieties of the cotton fiber. Methods employed in cultivating, marketing, grading and stapling are considered, and under these heads a detailed study is made of the types of gin employed.

Opening and Picking. — Instruction in the preliminary operation of opening and picking covers the mechanical construction of the machines, their parts and adjustments, as fully as the manufacturing results accomplished by the machines. This includes such construction details as evener, lap measuring and safety stop motion, grids, cleaning trunks, beaters, etc.; also operation details which involve the adjustment of waste, drafts and character of laps.

Carding. — The process of carding is considered one of the most important, and proper time is devoted to the construction and operation of cards that the student may be familiar with the various parts of the card and the function and design of each. The construction and application of card clothing, as well as the methods of grinding, form a part of the work.

Drawing. — Under this head is taken up the theory of doublings and their effect upon the quality of roving and yarn. Like previous and subsequent processes the machine construction forms an important part of the work. Proper stress is paid to such subjects as stop motions, drawing rolls and their covering, cleaners and evener motions.

Roving Processes. — Under this head are studied the various machines known as the slubber, intermediate, fine and jack fly frames. The relative motion of the various parts of these machines is so complex that a good opportunity is here presented to fix in the student's mind the application of certain mechanical principles that are used in other departments and upon other machines in the manufacture of textile material. With each process of yarn manufacture are explained the systems of sizing and numbering, and under this head are taken up both the metric and English systems.

Ring Spinning and Twisting. — The consideration of spinning yarn by the ring frame method involves a knowledge of the uses to which the yarn is to be put, subsequent methods of handling that proper roving may be selected, suitable amounts of draft and twist provided, correct size of rings and travelers selected, building motions suitably adjusted, etc. The operation of twisting yarns is so closely related to spinning by the ring method that it is studied at the same time.

This opens an almost limitless field of novelty yarn manufacture, and offers a very good opportunity to derive new types of yarn or new mechanism to produce the effects. Yarn defects are studied with reference to the cause and remedy.

Mule Spinning. — This method of spinning is very different from that of the ring frame, and the mechanical details are more complicated. The student is furnished with new means of producing yarns, and can compare the relative advantage of each method. A thorough understanding of mule spinning is perhaps more a study of mechanical motions and their functions. This results almost invariably in assisting the student to understand previous processes and machines better because of his work on the mule. It is the object to make clear to the student's mind the principles underlying the construction and operation of the parts that control the drawing, twisting, backing off, winding, together with such special motions and devices as are used upon the modern mule.

Combing. — This process is explained by lecture work and by operation and assembling of the various types of combs in service in the laboratory. The object of combing is fully considered, and the different means employed on the many types of combers on the market are studied. This includes such types as the Heilman, New Whitin and Nasmith combers.

WOOLEN AND WORSTED DEPARTMENT.

Woolen and Worsted Yarns.

Raw Materials. — A study of raw materials which enter into the manufacture of woolen or worsted yarns, or are made into yarns by processes similar to those employed in the manufacture of woolen and worsted yarns, would include silk, mohair, alpaca, vicuna, cashmere, camel's hair and cotton. In connection with these are considered shoddy, noils and extracts.

Wool Sorting. — Familiarity with the various grades and kinds of wool is obtained by lecture. The various characteristics and properties are explained, as are also trade terms, such as picklock, XXX, XX, ½-blood, ⅜-blood, ¼-blood, delaine, braid, etc. Some skill is acquired in the estimation of shrinkage and in judging and spinning qualities.

Wool Scouring. — The object of scouring and the methods employed are explained, and this involves the consideration of the soaps and chemicals used in washing; also the waste products and their utilization. Actual work is done in scouring a commercial quantity of wool by machines that are made similar in operation to regular commercial machines. A study is made of the effect of the hardness of water upon soap. At the same time the use of driers, their operation and regulation, is taken up, and the methods of carbonizing wool, noils, burr waste, rags, etc., are studied and explained.

Burr Picking, Mixing, Oils and Emulsions. — The use of burr pickers in cleaning wool and the use of mixing pickers in making color blends is covered by lecture and demonstration. Under the subject of oil and emulsions are taken up the characteristics of various oils and the means employed to test them.

This work is taken only by those students who are pursuing the Woolen Manufacturing Course.

Carding. — The different systems of carding wool, depending on whether it is to be made into woolen or worsted yarns, are fully explained, as is also the construction, setting and operation of cards. A part of this work consists of a study of card clothing, its construction, application and grinding.

Woolen Mule. — The student studies thoroughly the operation of the mule as a whole, and acquaints himself with the various principal mechanisms, as, for example, the backing off and winding motions, the quadrant, builder-rail, faller regulation, etc.

Top Making and Combing. — This branch takes up, besides the carding of the wool on a worsted card, the preparing processes, backwashing, also gilling of the stock before and after combing. The construction of the gill boxes and combs is studied by lectures. Later, quantities of stock are made into top and then into yarn.

The Noble, Lister and French combs are studied, and the various calculations to determine draft, noiling, productions, etc., are made.

Drawing and Spinning. — The equipment in the laboratory offers oppor-

tunity to make worsted yarn by either the Bradford or open drawing system or by the French system. The process includes the various machines in the successive steps of making Bradford spun yarn, and the functions of the different machines are studied. In the latter, or French system, the stock is run through the drawing machines, and the roving spun into yarn on the worsted mule. The same method of studying the mechanism and operations of these machines is followed as in the case of previous methods of instruction. The student by pursuing this course can compare the different methods of yarn manufacture and note the results of each.

With the instruction in spinning by the Bradford system is given work on the twisters and the effects that may be produced.

TEXTILE DESIGN AND WEAVING DEPARTMENT.

Textile Design.

During the first year instruction is given in the subject of classification of fabrics, use of point or design paper, plain fabrics, intersection, twills and their derivation, sateen, basket and rib weaves, checks and stripes, fancy weaves, including figured and colored effects; producing chain and draw from design, and *vice versa;* extending and extracting weaves.

For Cotton Goods.

During the second year consideration is given to fancy and reverse twills, diaper work, damasks, skip weaves, sateen fabrics with plain ground, backed fabrics, and multiple ply fabrics. Students are required to make original designs. Special attention is given to the consideration of color effects.

The analysis of these fabrics forms a part of the course in design. This also includes the necessary calculations required to reproduce the fabric or to construct fabrics of similar character.

For Woolen and Worsted Goods.

During the second year the instruction given includes warp and filling backed cloth, figured effects produced by extra warp and filling, double cloths, multiple ply fabrics, cotton warps, blankets, bath robes, crêpes, filling reversible, Bedford cords, imitation furs, crêpons, matelasse and imitations, double plain, ingrains, velvets, corduroys, overcoatings, trouserings.

The analysis of these fabrics, together with the consideration of the shrinkages and dead loss in all fabrics, theory of diameter of yarns, and costs of mixer blends, is a part of this course.

The advanced work takes up the more complicated weaves adapted to harness work, and leads into leno and Jacquard designs. The following is a brief list of the subject heads, which will give some idea of the course: double plain cloths, ingrains, tricots, chinchilla, tapestry, blankets, upholsteries, spot weaves, pile or plush, crêpon, matelasse and its imitations, piqué, marseilles, quilting and miscellaneous designs for Jacquard, leno, fustian, tissue fabrics and lappets.

Cloth Analysis.

In the first year this subject takes up in a systematic manner the analysis of samples illustrating the various cloth constructions for the purpose of determining the design of the weave and the amount and kind of yarns used, and forms the basis of calculation in the cost of reproducing any style of goods. The various topics discussed are reeds and setts; relation and determination of counts of cotton, woolen, worsted, silk and yarns made from the great variety of vegetable fibers; grading of yarns, folded, ply, novelty and fancy yarns; application of the metric system to yarn calculation; problems involving take-up, average counts, determination of counts of yarn, and weight of yarn required to produce a given fabric.

Cloth Construction.

The work includes the application of the different weaves and their combinations in the productions of fancy designs, both modified and original; the calculation involved in the reproduction of standard fabrics changed to meet varying conditions of weight, stock, counts of yarn and value.

Instruction in this subject, which is given by classroom work, is intended to

bring together the principles considered under the subject of design, cloth construction, weaving and yarn making of previous years, and to show the bearing each has in the successful construction of a fabric.

Power Weaving.

Instruction in cotton weaving is carried on upon power looms in connection with the work in Textile Design and Cloth Analysis. This includes a study of the preparation of warps, beaming, dressing, sizing, drawing-in and making of chains, the cutting and lacing of cards, spooling and quilling and the machinery for the same. A study is made of warpers and sizing machines, both for cotton and woolen. Lectures are given to correspond with the progress of the student in the Power Weaving Laboratory covering the following subjects: loom adjustments, chain building, shuttle changing looms, dobby looms, single and double acting dobbies, handkerchief motions, leno weaving, center selvedge motions, filling changing looms, oscillating reeds, lappet motions, various shaker motions, towel and other pile cloth weaving, Jacquard looms, single and double lift leno Jacquards, Jacquards of special design, tying up Jacquard harness. Instruction is also given in weaving on fancy woolen and worsted looms.

Cotton Weaving.

The course in Cotton Weaving covers instruction on plain looms, Draper Automatic looms, and also on the Stafford Automatic looms. It includes instruction on the construction of shedding and picking motions, take-up and let-off motions together with the operation of the magazines and hoppers and methods of changing shuttle and bobbin. Instruction is also given on the Crompton and Knowles Automatic Towel Looms and the various types of box looms, including chain building and work on multipliers.

Woolen and Worsted Weaving.

This course includes instruction on the Crompton and Knowles loom and takes up general construction, head motions, take-up, let-off, filling stop motion, etc. The course also includes warp preparation.

Dobby and Jacquard Weaving.

This course considers the various types of Jacquard heads and dobbies, which includes single cross border dobbies and leno attachments on double lift dobbies. The course on Jacquard looms includes general construction and card cutting, lacing, repeating, and fixing.

CHEMISTRY AND DYEING DEPARTMENT.

General Elementary Chemistry (Inorganic and Organic Chemistry).

Instruction in Elementary Chemistry extends through two years, and includes lectures, recitations and a large amount of individual laboratory work upon the following subjects:—

Theoretical Chemistry. — Chemical action, chemical combination, combining weights, atomic weights, chemical equations, acids, bases, salts, Avogadro's law, molecular weights, formula, valence, periodic law, etc.

Non-metallic Elements. — Study of their occurrence, properties, preparations, chemical compounds, etc.

Metallic Elements. — Study of their occurrence, properties, metallurgy, chemical compounds, etc.

The students take up, as thoroughly as time will permit, the qualitative detection of the more common metals and non-metals, with practical work.

This work, although necessarily elementary, is intended to prepare the student to more understandingly study the manufacture of dyestuffs, and coal tar colors in the more advanced courses which follow.

Qualitative Analysis.

The laboratory work during the second year of the Elementary Chemistry course consists entirely of Qualitative Analysis. While this course is necessarily taken up in an abbreviated and elementary manner, it is so arranged that the students may become familiar with the separations and the detections of the common metals and acids. This course is also preliminary to the work given in Analytical Chemistry.

During the first year of the Elementary Chemistry course most of the time will be devoted to the non-metals and theoretical chemistry, and the laboratory work will be briefly upon the non-metals.

During the second year the classroom work will be upon metals and the hydrocarbons and their derivatives, and the laboratory work will be qualitative analysis.

Textile Chemistry and Dyeing.

The outline of the lecture course given in Textile Chemistry and Dyeing is as follows:—

Technology of Vegetable Fibers. — Cotton, linen, jute, hemp, china grass. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Animal Fibers. — Wool, mohair, silk. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Artificial Fibers. — Study of the various forms of artificial silk, the process of manufacture, their properties and action with chemicals, acids and heat.

Operations preliminary to dyeing. — Bleaching of cotton and linen; wool-scouring; bleaching, fulling and felting of wool; carbonizing; silk-scouring and bleaching; action of soap.

The bleaching of cotton is studied with description of the various forms of kiers and machinery used; also the action of the chemicals used upon the material, and the various precautions that must be taken in order to insure successful work.

Under this heading is included a study of the reagents used in the emulsive wool-scouring process, and their action upon the fiber under various conditions; also the most successful of the solvent methods for degreasing wool.

Water and its Application in the Textile Industry. — Impurities present methods for detection, their effect during the different operations of bleaching, scouring, dyeing and printing, and the methods used for their removal or correction.

The important subject of boiler waters is also studied under this heading, with a full discussion of the formation of boiler scale, its disastrous results, and the methods by which it may be prevented.

Mordants and Other Chemical Compounds used in Textile Coloring, and Classified as Dyestuffs. — Theory of mordants, their chemical properties and application, aluminum mordants, iron mordants, tin mordants, chromium mordants, organic mordants, tannin materials, soluble oil, fixing agents, leveling agents, assistants, and numerous other compounds not dyestuffs that are extensively used in the textile industry.

Under this heading are included the definitions of various terms and classes of compounds used by textile colorists, such as color lakes, pigments, fixing agents, developing agents, mordanting principles and leveling agents.

Natural Organic Coloring Matters. — Properties and application of indigo, logwood, catechu or cutch, Brazil wood, cochineal, fustic, turmeric, madder, quercitron bark, Persian berries, and other natural dyestuffs that have been used in recent years by textile colorists.

Mineral Coloring Matters. — Under this heading are discussed the properties of such inorganic coloring matters and pigments as chrome yellow, orange and green, Prussian blue, manganese brown, iron buff.

Artificial Coloring Matters. — General discussion of their history, nature, source, methods of manufacture, methods of classification and their application to all fibers.

Special study of basic coloring matters, phthalic anhydride colors, including the eosins and phloxines; acid dyestuffs, Janus, direct cotton, sulphur and mordant colors, including the alizarines and other artificial coloring matter requiring metallic mordants; mordant acid and insoluble azo colors, developed on the fiber; reduction vat colors, aniline black and other artificial dyestuffs not coming under the above heads.

As each class of dyestuffs is taken up the details of the methods of applying them upon all the different classes of fabrics and in all the different forms of dyeing machines are thoroughly discussed; also the difficulties which may arise in their application, and the methods adopted for overcoming them.

MACHINERY USED IN DYEING. — A certain amount of time is devoted to the description of the machinery used in the various processes of textile coloring, which is supplemented as far as possible by the use of charts, diagrams and lantern slides.

During the third year of this course, if time permits, the more advanced subjects of union dyeing, textile printing, dye testing, color matching and color combining will be briefly considered.

Dyeing Laboratory.

Besides lectures and recitations upon the subject of Textile Chemistry and Dyeing, practical laboratory work is required. By the performance of careful and systematic experiments the student learns the nature of the various dyestuffs and mordants, their coloring properties, their action under various circumstances, and the conditions under which they give the best results. The more representative dyestuffs of each class are applied to cotton, wool and silk, and each student is obliged to enter, in an especially arranged sample book, a specimen of each of his dye trials with full particulars as to the conditions of experiments, percentage of compounds used, time, temperature of dye bath, etc.

For convenience and economy most of the dye trials are made upon small skeins or swatches of the required materials, but from time to time students are required to dye larger quantities in the full-sized dyeing machines.

Analytical Chemistry.

The object of this course will be to give the student a general idea of the underlying principles of Analytical Chemistry, with a sufficient amount of laboratory work to enable him to become proficient in performing the ordinary routine analysis of the textile plant. Frequent recitations will be held for the discussion of methods and the solution of stoichiometrical problems.

The work covered the first two years is based on Smith's "Quantitative Analysis," and for the advanced work, consisting of the analysis of soap, water, oils, cloth and other materials of particular interest to the textile chemist, special lecture notes and Griffin's "Technical Methods of Analysis" is used as a text.

TEXTILE ENGINEERING DEPARTMENT.

Mechanics and Mechanism.

This is one of the most important of engineering subjects and is therefore a subject common to all engineering courses. It deals with the principles which underlie the transmission of force and motion. Beginning with a discussion of such important topics as work, power, horsepower, energy and the like, the student then studies the fundamental mechanical principles which are exemplified by the lever, jackscrew, pulley block, inclined plane, wedge, differential pulley and other similar devices. This is followed by consideration of the simpler relations pertaining to uniform and accelerated motion and the course concludes with a study of pulleys, belting, gears and gearing, as far as time permits. No student should undertake this course who is not thoroughly familiar with such elementary mathematics as is described under Shop Mathematics.

Strength of Materials.

This interesting subject deals with the fundamental principles whereby the man engaged in machine, engine, mill, or building design may ascertain whether the parts are strong enough to carry the forces and loads which the nature of the construction imposes upon them. The fundamental stresses of tension, compression and shear are considered, together with the ultimate strength of cast iron, wrot iron, steel, and timber. The practical use of this information is illustrated in the design of bolts, tie rods, columns, wall piers, boiler shells, riveted joints, etc. This is followed by a study of the stresses in and design of beams under various conditions of loading, and the course concludes with a discussion

of the torsional stresses and twist in shafts. A knowledge of the principles of Mechanics and Mechanism is necessary to a satisfactory understanding of this subject.

Mechanical Drawing (Course VIb).

This (Course VIb) is the complete course in drawing and requires two evenings per week for three years for its completion. The work in this course is so planned that at its completion a man shall be thoroughly familiar with the making of a working or shop drawing. After a study of the underlying principles of projections and instruction in penciling, inking, lettering and tracing, the subject of sketching and the making of detail drawings therefrom is especially stressed. The preparation of assembly drawings is finally considered. Shop mathematics is a prerequired subject.

Mechanical Drawing (Courses VIa-VId).

The work required in this subject follows the same plan as described for Coursse VIb. Although the time allotted to this subject is only one-half that given in Course VIb, nevertheless the student acquires a good knowledge of the fundamentals of mechanical drawing.

Steam.

The instruction in this subject covers, so far as time permits, the elements of steam engineering. The topics covered are heat and its measurement, use of steam tables, types of boilers, engines and turbines, boiler and engine room accessories, together with a study of the methods of testing the various types of apparatus. Actual tests on such equipment are made as the size of the class permits.

Electricity.

This subject deals entirely with the theory and application of direct currents. The main topics treated are —

Magnetism.	Simple alternating current circuits.
Theory of electric currents.	Wiring.
Direct current generators and motors.	Transmission.
Measuring instruments.	

Mathematics — First Year.

This subject is a continuation of the work in Shop Mathematics, and is intended as a foundation for the advanced courses in engineering. Some of the topics treated are —

Elementary algebraic operations of —	
Addition.	Division.
Subtraction.	Factoring.
Multiplication.	Fractions.

Mathematics — Second Year.

Before taking this subject it is advisable that the student should be well grounded in the essentials of plane geometry. A general outline of the subject follows:

Linear equations.	Slide rule.
Theory of indices.	Quadratic equations.
Graphical representation.	Trigonometry.
Logarithms.	

Shop Practice.

This subject is covered by a series of lectures on care and management of machine-shop tools leading up to the actual operation of the same.

Shop Mathematics.

By this topic is meant the practical application of arithmetic, geometry and algebra to everyday problems, which are covered are, briefly, addition, subtraction, multiplication, division, common and decimal fractions, ratio and proportion, common areas and volumes, and simple equations involving one unknown.

FINISHING DEPARTMENT.

Woolen and Worsted Finishing.

The outline of this course, which is given chiefly by means of lecture work, is as follows:—

Burling and Mending. — Under this head are taken up for consideration the examination of flannel as it comes from the loom; the construction, use and location of the perch; the methods used in marking defects, measuring, weighing and numbering of cloths; also the methods of inspection for fancies, single cloths and double cloths. The object of burling, mending and the types of tables employed, the method of removing knots, runners, etc., the object of back shearing and the use of burling irons, the replacing of missing threads and the importance of sewing as a part of the finishing process, are all considered in detail. The removal of oil and tar spots as well as stains of various kinds is studied.

Fulling. — This branch covers a study of the conditions of the flannel as it comes from the loom, and the influence of oil, etc., upon the procedure. Considerable time is devoted to the various methods of producing a felt, the early types of stocks, hammer falling and crank stocks, and their modifications and development into the present type of rotary fulling mills of both the single and double variety. The details of construction in all machines are carefully taken up and include the design and composition of the main rolls, methods of covering, regulation and means of adjusting the pressure of traps and rolls, consideration of the shoes, the use and regulation of the various types of stop motion, the different types of stretchers, guide rolls and throat plates.

The theory of felt is taken up and the influence of pressure, moisture, heat, alkali and acid is considered, as well as the hydroscopic and felting properties of different wool fibers. The preparation of the flannel for the mill and the usual methods of determining shrinkages, as well as the various methods of soaping, are given careful attention. The preparation of various fulling soaps and the value of each for the production of various degrees of felt, as well as the determination of the proper amount of alkali for various goods, are carefully studied and demonstrated. The manipulation of the various kinds of goods in the mill, viz., all wool, shoddies and mixed goods, is studied in classroom and by operation in the mill.

The change in weight and strength for each operation is carefully considered, as is also the value of the flocks made in each. A study of the various methods of flocking, such as dry and wet, is considered in both class and machine rooms. In each operation the defects likely to materialize are studied, as well as the cause thereof, and various methods of modifying or lessening them.

Washing and Speck Dyeing. — This branch considers the scouring, rinsing and washing of goods both before and after the fulling process; the various types of washers; and the details of construction, such as suds box, rolls, etc. The theory of scouring, uses of Fuller's earth, salt solutions and sours on the different kinds of goods are made clear by practical work in the machine room, where the effects due to improper scouring, such as stains, cloudy effects, wrinkles and unclean goods, are demonstrated. The discussion of the necessity of speck dyeing folows naturally from the study of these matters, and includes methods of preparation, materials used, application and tests required.

Carbonizing. — This is an important branch of finishing, and includes a study of the various carbonizing agents, methods of application, strength of solutions and neutralizing, as well as the machines used. Stains and imperfections resulting from carbonizing are also considered. The drying and tentering machines and extractors employed are taken up at this point.

Gigging, Napping and Steaming. — The construction in detail of the various types of gigs, nappers, steamers, wet gigs, rolling, stretching, crabbing and singeing machines is discussed, and their actions upon the cloth and the results obtained are explained.

Various methods of obtaining luster and the production of permanent finish are considered in connection with steaming and sponging.

Brushing, Shearing and Pressing. — This includes, as do the other branches, a careful treatment of the machine employed, the preparation of the cloth for each process, the action of each machine in producing its part of the resultant effect. In manipulation of the shear consideration is given to its setting, grinding and adjustment. With the brushing machine the effect of steaming and moisture upon the luster and feel of the goods is shown. A study of the action of the presses, both plate and rotary, involves consideration of pressure, steam-

ing, etc. Special processes to obtain particular effects are taken up, and the part played by each machine is explained. The details involved in handling cloth on a commercial scale, as, for example, measuring, weighing, ticketing, numbering and rolling, are also explained. The necessary calculation and the methods of finishing all grades of goods are considered from time to time during the year.

Cotton Finishing.

The outline of the course in the finishing of cotton fabrics is as follows:—

Cloth Room. — Instruction of the various goods and the object thereof; construction of the various types of inspecting and trimming machines.

Shearing. — The object. A consideration of the various types of shears for treating one or both sides at the same time; also the use of the usual cleaning devices, such as emery, sand and card rolls, beaters and brushes; grinding and the adjustment of the various parts.

The use of brushing and cleaning machines, rolling devices and calendar attachments for gray goods.

Singeing. — Developing and object of singeing; the construction of singers of all types, and for various purposes; the use of cooling tanks, steaming devices, rolling and brushing attachments.

Regulation of the flame for various goods, and adjustment of the parts; gas and air pressure; water-cooled rolls; the effect of moisture on the cost of singeing; the use of dry cans in connection with singeing; electric singeing.

Washing. — Open width and string washers, their construction and operation; soaps, temperature, squeeze rolls; washing of various goods and the object thereof; stains.

Napping. — The object of napping and the usual method of treating goods; various types of nappers, single and double acting; felting nappers; construction, grinding and adjustment of various types.

Water Mangles. — Their object and the construction of various types; various rolls, — iron, husk, etc.; scutchers, their object and constructions.

Starch Mangles. — The object and construction of all types of starch mangles for pure starch and filled goods; various types of rolls,— brass, rubber, wood; action of doctor blades, etc.; regulation and object of pressure.

Methods of starching and finishing all standard goods, also a consideration of the various substances used, such as starch, softener and fillers; the preparation of starch and various methods of application.

Dryers and Stretchers. — Both horizontal and vertical, tenter frames, clips; the swing motion and the finishes thus produced; construction; spraying machines, belt stretchers, button breakers; their object and construction.

Calenders. — The object and construction of all types, including the regulation of pressure and nips for the production of various finishes; various types of rolls and their uses, — steel, husk and paper; the use of hot and cold rolls; chasing, friction, embossing and Schriner calenders and the various finishes produced by each; production of watered effects; beetling machines.

Making up room, — yarding, inspecting; different types of folds; pressing, papering, marking.

OLNEY CHEMICAL ALUMNI OF THE LOWELL TEXTILE SCHOOL.

This association was organized in 1908 for the purpose of keeping its members in closer relationship with each other and with the school.

The membership consists of evening graduates from any of the advanced courses in chemistry and dyeing of the Lowell Textile School, and is composed of one hundred and fifty members at present.

The annual meeting is held during the winter months, and the annual reunion is held the third Saturday of June at a place selected by the Board of Control.

Officers.

President, Henry D. Grimes, Lawrence, Mass.
Vice-President, Henry K. W. Torpey, Lowell, Mass.
Secretary and Treasurer, Reginald C. Atkinson, Lowell, Mass.

Board of Control.

Alfred Peever, Methuen, Mass., three years.
Samuel Stott, Lowell, Mass., three years.
Albert Blades, Lowell, Mass., two years.
Winthrop Bean, Lowell, Mass., two years.
George Stewart, Lowell, Mass., one year.
William F. Brandy, Lawrence, Mass., one year.

This association will offer each year a book prize to the evening graduate who attains the highest standing in any of the advanced courses of the Chemistry and Dyeing Department.

For information regarding this association please apply to Reginald C. Atkinson, 59½ South Whipple Street, Lowell, Mass.

The winner of this prize for 1920 was Joseph G. Laycock, Lowell, Mass.

EVENING GRADUATES OF 1924.

Certificates awarded as follows, April 9, 1924:—

August, 1924

Course I (Cotton Manufacturing) — 4 Years.

Harold Bostron Entwistle	Lowell, Mass.
Archibald Duncan Grant	Lowell, Mass.
Arthur Joseph Woodbury	Lowell, Mass.

Course Ia (Cotton Yarns) — 3 Years.

Seth Wilson Hall	Lowell, Mass.

Course Ib (Knitting) — 1 Year.

Bliss Anderson Bowser	Lowell, Mass.
Ariston Grover	Chelmsford, Mass.
John Petty	North Andover, Mass.

Course II (Wool Manufacturing) — 4 Years.

Albert Irvin Alexander, Jr.	Lawrence, Mass.
Michael Pancratius Gilmore	Lowell, Mass.
Joseph Marsden	Methuen, Mass.
Alban Clifford Nelson	Lowell, Mass.
William Madison McPhee Shepard	North Billerica, Mass.

Course 11a (Woolen Yarns) — 1 Year.

Anatole Grenon	Lowell, Mass.
Donald Joslyn Field	Lowell, Mass.
Michael Henry Kelly	Lowell, Mass.
James Joseph MacDonald	Boston, Mass.
William Rubin	Chelsea, Mass.
John George Stickler	Lowell, Mass.

Course IIb (Worsted Yarns) — 2 Years.

Albert George Forty	Graniteville, Mass.
Harold Lawrence Richardson	Lawrence, Mass.
Albert Edward Taylor	Methuen, Mass.
Harold Davison Watmough	Lawrence, Mass.

Course IIIa (Cotton Design) — 3 Years.

Harry Dickinson	Lowell, Mass.
William Edward Dickinson	Lowell, Mass.
John Robert Hancock	Lowell, Mass.
Lillian Rock Laird	Lowell, Mass.
Ivar Oscar Moberg	Lowell, Mass.
John George Parker	Lowell, Mass.
Harold Parkinson	Lowell, Mass.

Course IIIb (Woolen and Worsted Design) — 3 Years.

Omer John Bedard	Lowell, Mass.
Albert James Brennan	Lowell, Mass.
Arthur Clough	Methuen, Mass.
Richard Francis Condon	North Billerica, Mass.
William Henry Donahue	Lowell, Mass.
Fador Ebersbach	Lawrence, Mass.
William Frederick Entwistle	Lowell, Mass.
Donald Joslyn Field	Lowell, Mass.
Harold Arthur Giffin	Lowell, Mass.
Ralph Seth Giffin	Lowell, Mass.
George Edward Hertrich	Lawrence, Mass.
John Edwin Hilton	Worcester, Mass.
George Herbert Hull	North Billerica, Mass.
Thomas Joseph Kirwin	Lowell, Mass.
Gordon Drummond Lodge	Methuen, Mass.
William Coit Osgood	Andover, Mass.
George William Smith	Lawrence, Mass.
Herman Winway Weinhold	Lawrence, Mass.

Course IIIc (Freehand Drawing) — 3 Years.

Natalie Caroline Ladau	Lowell, Mass.
Carl John Oscar Santesson	Lowell, Mass.

Course IVa (Elementary Chemistry) — 2 Years.

Elizabeth Philomena Burns	Lowell, Mass.
James Walter Callahan	Lowell, Mass.
Frederick Flather	Lowell, Mass.
James Albert Fortune	Methuen, Mass.
Albert Christian Johnson	Lawrence, Mass.

William Kelly	Lowell, Mass.
Samuel Edward Lord, Jr.	Lowell, Mass.
Joseph Christopher McInerney	Lowell, Mass.
John Francis McNulty	Lawrence, Mass.
Thomas Francis Markey	Lawrence, Mass.
Robert Paul Murphy	Lowell, Mass.
John Ashworth Peel	North Andover, Mass.
Frank Albin Ringe	East Dedham, Mass.
Frederic William Spedding	Lawrence, Mass.
Sumner Henry Williams	Lowell, Mass.

Course IVb (Textile Chemistry and Dyeing) — 3 Years.

Jack Wilson Binns	Lawrence, Mass.
Pasquale Pasce DeNuccio	Lawrence, Mass.
James Edward Doole	Lowell, Mass.
Roland Francis Kittredge	Lawrence, Mass.
Joseph Greenwood Laycock	Lowell, Mass.
James William Wallace Logan	Lowell, Mass.
John Petty	North Andover, Mass.
Henry Thomas Rooney	Lawrence, Mass.

Course IVb (Textile and Analytical Chemistry) — 4 Years.

Mark Loyne Davis	Methuen, Mass.
David Chapman Hardman	Lowell, Mass.

Course Va (Cotton Weaving) — 1 Year.

Seth Wilson Hall	Lowell, Mass.
William Thomas Prescott	Lawrence, Mass.
Roy Evans Snow	Nashua, N. H.

Course Vb (Woolen and Worsted Weaving) — 2 Years.

Daniel Joseph Collins	Dracut, Mass.
Richard Francis Condon	North Billerica, Mass.
William Frederick Entwistle	Lowell, Mass.
Daniel Ross Haggart	Lowell, Mass.
George Edward Hertrich	Lawrence, Mass.
John Edwin Hilton	Worcester, Mass.
Frank Joseph Kenny	Lowell, Mass.
Thomas Joseph Kirwin	Lowell, Mass.
George William Smith	Lawrence, Mass.
Eugene Mard Therrien	Lowell, Mass.

Course Vc (Dobby and Jacquard Weaving) — 1 Year.

William Henry Donahue	Lowell, Mass.
Clarence Edward Hartley	Lowell, Mass.
Ivar Oscar Moberg	Lowell, Mass.
Abraham Rondeau	Lowell, Mass.

Course VIa (Engineering) — 3 Years.

Paul Patrick Cashman	Lowell, Mass.
Leo Edward Gaudette	Lowell, Mass.
William Hallwich	Lowell, Mass.
Richard Edward Picking	Lowell, Mass.

Course VIb (Mechanical Drawing) — 3 Years.

Raymond Atchinson Alden	Lowell, Mass.
George Raymond Ayer	Methuen, Mass.
Daniel James Crowley	Lowell, Mass.
Ernest Harold Frasier	North Billerica, Mass.
George Edward Neal	Lowell, Mass.
Walter Jerome Patnaude	Lowell, Mass.
John Francis Vaughan	Lowell, Mass.

Course VIe (Advanced Electricity) — 1 Year.

William Edward Porter	Lowell, Mass.
Maurice Joseph Powers	Lowell, Mass.
Hugh Alexander Ross	Lowell, Mass.
Joseph Christopher Taff	Lowell, Mass.

Course VIIa (Cotton Finishing) — 1 Year.

Horatio Hallsworth	Lowell, Mass.
Joseph John Higginbottom	Lowell, Mass.
Klondyke McKinley Thomas	Methuen, Mass.
Russell Adams Wells	Boston, Mass.

Course VIIb (Woolen and Worsted Finishing) — 1 Year.

James Leo Batts	Lawrence, Mass.
John Foster Cass	Lawrence, Mass.
Edmund Ives Damon	Lawrence, Mass.
Robert Heman Dole	Lowell, Mass.
James Edward Doole	Lowell, Mass.
Charles Hawes Doty, Jr.	Lawrence, Mass.
Donald Joslyn Field	Lowell, Mass.
John Edwin Hilton	Worcester, Mass.
Merton Francis Merrick	Lawrence, Mass.
William Coit Osgood	Andover, Mass.
Everett Stevens	Lawrence, Mass.

SERIES 28. No. 2 November, 1924

BULLETIN

OF THE

Lowell Textile School

LOWELL, MASS.

Issued Quarterly

1924-1925

Entered August 26, 1902, at Lowell, Mass., as second-class matter
under Act of Congress of July 16, 1894
Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized October 21, 1918

Moody Street and Colonial Avenue

Publication of this Document
approved by the
Commission on Administration and Finance

THE EFFECT OF REGAIN UPON THE STRENGTH AND ELASTICITY OF A WORSTED YARN

NOTE.—This bulletin contains an abstract of the thesis prepared by Philip R. Lowe, class of 1924. It is not to be presumed that the results are applicable to the entire range of worsted fabrics but represent a beginning of investigation that may be made exhaustive.

Suggestions and questions by readers will be helpful in directing future research.

The object of these experiments was to determine the variation of strength and elasticity with varying amounts of regain in certain standard worsted fabrics.

The fabrics used in this test were representative coarse and fine worsted fabrics. They were constructed of all wool and were manufactured by the same concern. Their particulars were as follows:

No. 1—Dress Serge
7.76 oz. 51 inches between selvedges
60 threads 52 picks
2/36's worsted warp. 1/27's worsted filling

No. 2—Poiret twill
7.97 oz. 42½ inches between selvedges
100 threads 60 picks
2/40's worsted warp. 1/50's worsted filling

The "strip" method as prescribed by the American Society for Testing Materials was followed. Each strip was ravelled down from one and three-eights inch width to the count number for warp and filling per inch. The lengths of strips varied from eight to ten inches.

The breaking strength of each strip was made on a Scott testing machine located in a special room where the humidity could be maintained at any desired point from one hundred per cent to normal atmosphere. This was accomplished by means of a Parks-Cramer Humidifying Head and an automatic Parks-Cramer control. The temperature was maintained at seventy degrees Fahrenheit.

The test strips were taken systematically from different locations in the respective fabrics and were cut both warp ways and filling ways. An average of five strips was made for each determination. After the tests for breaking strengths were made upon each set of samples, these were placed in an air-tight container from which they were later taken to an Emerson Conditioning Oven to determine the regain.

From the data obtained curves were plotted from which four have been selected to present herewith. They are intended to show the relationship existing between the amount of regain to the strength and elongation of each fabric tested.

The author draws the following conclusions:—

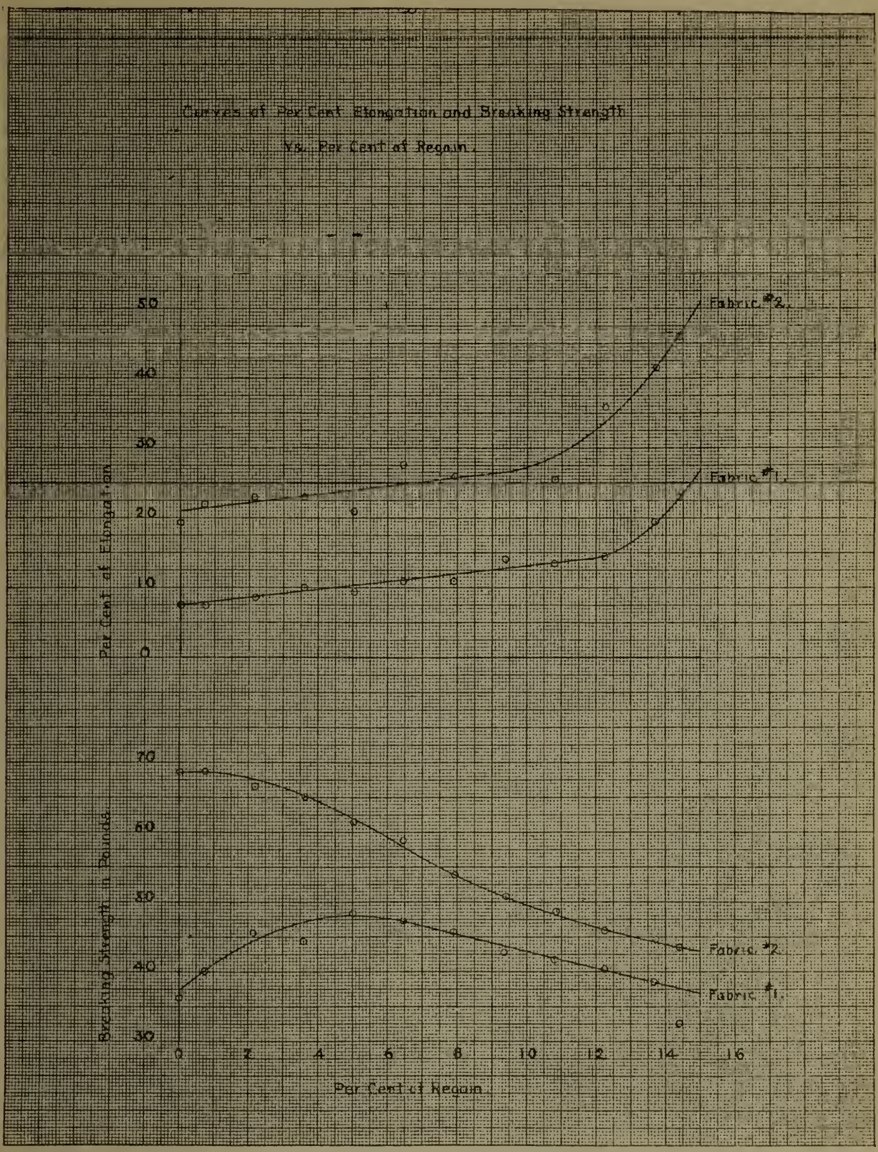
The results obtained by these tests are applicable strictly to the two particular fabrics.

The breaking strength of a worsted fabric is greatly decreased by an increase in regain, and the rate of decrease is not uniform with uniform increase in regain.

The elongation of a worsted fabric is greatly increased with increase in regain, but the increase is not in the same ratio as the regain.

Regain has a greater effect on the strength and elasticity of a high count, closely constructed worsted fabric than on a medium or low count more openly constructed fabric.

If a worsted fabric is to undergo any tests for breaking strengths or elongation it is of the utmost importance that the atmospheric conditions under which the tests are to be made are specified because the results obtained vary with the regain.



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Clerk.

THE LOWELL TEXTILE SCHOOL.

History.—The Lowell Textile School was established by the Trustees of the Lowell Textile School of Lowell, Massachusetts, incorporated in accordance with chapter 475, Acts of 1895. The movement for the establishment of the school dates from June 1, 1891, but it was not opened for instruction until February 1, 1897.

In accordance with the acts of incorporation the Board of Trustees consisted of twenty permanent and self-perpetuating members, three-fourths of whom must be "actively engaged in, or connected with, textile or kindred manufactures." In addition, His Honor the Lieutenant-Governor, the Commissioner of Education of the State, the mayor, the president of the municipal council, the superintendent of schools of Lowell, and a representative of the textile council were members *ex officio*. Legislative acts of 1905 and 1906 authorized the graduates of the school to elect four trustees serving for periods of four years each.

By virtue of the anti-aid amendment to the State Constitution, and by chapter 274, General Acts of 1918, the property of the school was transferred on July 1, 1918, to the Commonwealth of Massachusetts, and the control and management of the school was vested in a Board of Trustees

appointed by the Governor, "with all the powers, rights and privileges and subject to all the duties" of the original Board.

In locating the school at Lowell, which has been called the "Mother Textile City of America," considerable advantage is secured by close association with every branch of the industry, which utilizes almost every commercial fiber in the products of the great Merrimack Valley textile district.

Although the school was formally opened by Governor Roger Wolcott on January 30, 1897, in rented quarters in the heart of the city, it was not until January, 1903, that the first buildings of the present plant were ready for occupancy. On February 12, 1903, Governor John L. Bates dedicated the present buildings.

Object.—The object of the establishment of the school as set forth in the original act was "for the purpose of instruction in the theory and practical art of textile and kindred branches of industry."

The plan was occasioned by the apparent crisis in the leading industry of New England, due to the rapid development of the manufacture of the coarser cotton fabrics in the southern States. It was believed that this crisis could be met only by a wider and more thorough application of the sciences and arts in the production of finer and more varied fabrics.

Following the general methods and systems found successful at the higher polytechnic institutes, it offers thorough instruction in principles of the sciences and arts applicable to textile and kindred branches of industry. The courses treat not only of the theory but also the application of these principles in the processes, on the machines and throughout all departments of industry involved in the successful manufacture, application and distribution of textile material in any form.

Because of the breadth, grade and character of instruction given, and because of the standing and personnel of the instructing staff, the school has been placed by both Federal and State educational boards in the class of the higher technological schools of this country.

Though from the first the management has kept in view the clearly defined objective which called for the establishment of the school, to meet the needs of the textile and kindred industries, it has developed its curriculum, its methods of instruction, and equipment as those needs arose. This objective will be kept constantly in view, and as new demands are presented an effort will be made to extend courses, equipment and floor space. The mechanical equipment of the school includes the best makes of textile machinery, and these machines, while built as they would be for regular work, are, as far as possible, adapted to the experimental work which is of particular value in such an institution as this. There is a more varied equipment in this school than in any other, either in America or Europe, and it is now possible to convert the raw stock into the finished fabric within the school.

The day classes have been organized for those who can devote their entire time for three or more years to the instruction requisite in preparing to enter the textile industries. It has been found necessary to require of all such students educational qualifications equivalent to those given by a regular four-year course of a high school or academy of good standing.

The evening classes are held for about twenty weeks of the year, and are for those who are unable to attend the day courses. These are similar to the day courses, but are aimed especially to meet the needs of students working during the day in the mills and shops. For entrance to these classes an applicant should have the equivalent of a grammar school education. A detailed description of these courses and requirements is given in another Bulletin, which will be sent upon request.

The trustees and faculty of the school confer the degrees of Bachelor of Textile Engineering (B.T.E.) and Bachelor of Textile Chemistry (B.T.C.) upon those students who satisfactorily complete one of the prescribed four-year courses. A diploma is awarded to those who satisfactorily complete one of the three-year courses.

The growth of the school is evident from the fact that when it was opened February 1, 1897, there were 32 day and 110 evening pupils. The present

school year of 1924-25 shows a registration of 230 pupils in the day classes and 677 in the evening classes.

CALENDAR.

1924.		1925.
September 11–12	Entrance examinations.	September 17–18
September 15-20	Re-examinations.	September 21–26
September 29	Registration.	September 28
September 30	Opening of day school.	September 29
October 12	Columbus Day, a holiday.	October 12
November 26	School closes at 4.30 P.M.	November 25
	THANKSGIVING RECESS.	
December 1	School opens at 8.45 A.M.	November 30
December 19	School closes at 4.30 P.M.	December 18
1925.	CHRISTMAS VACATION.	1926.
January 5	School opens at 8.45 A.M.	January 4
January 26	Semi-annual examinations begin.	January 25
February 6	End of first term.	February 5
February 9	Opening of second term.	February 8
February 22	Washington's Birthday, a holiday.	February 22
April 15	School closes at 4.30 P.M.	April 14
	SPRING RECESS.	
April 20	School opens at 8.45 A.M.	April 20
May 25	Final examinations.	May 24
May 30	Memorial Day, a holiday.	May 30
June 9	Graduation.	June 8
June 11–12	Entrance examinations.	June 10–11

DAY CLASSES.

ENTRANCE REQUIREMENTS.

Degree Courses.

Candidates for admission to either of the degree courses must be graduates of a school approved by the New England College Entrance Certificate Board or by the Board of Regents of New York, and must present a certificate from the principal of the school last attended, reporting upon the subjects pursued and the points obtained according to the schedule of studies given hereafter. A total of fourteen points is required.

A point represents satisfactory work in a year's study in a specified subject in an approved secondary school.

Required Subjects.	Points.
Algebra A1,	1
Algebra A2,	1
English,	3
Elementary French A (two years) or Elementary German A (two years)	2
Plane Geometry,	1
History (American, Mediæval and Modern, or English),	1
Physics,	1
	10

Elective Subjects.	
Chemistry,	1
English,	1
Elementary French (two years) or Elementary German (two years)	2
Advanced French or German (one year in addition to requirements of Elementary French A or Elementary German A),	1

History:	
American,	1
Mediæval and Modern,	1
English,	1
Latin,	1
Mechanical Drawing,	1
Mechanic Arts,	1
Solid Geometry,	1
Spanish,	1
Trigonometry,	1

An applicant may also be admitted on the basis of entrance examinations in which case he must pass a sufficient number of the required subjects to make ten points, and present certificates showing satisfactory courses in such of the elective subjects to make four additional points.

The object of the elective requirements is to encourage greater breadth of preparation than that covered by the required branches. Certificates covering other subjects than those listed as elective will be entertained.

Diploma Courses.

Candidates for admission to the diploma courses are accepted upon presentation of properly vouched certificates showing the completion of a regular four-year course in a high school or academy of reputable standing. The certificate must specify that the applicant has satisfactorily passed the required subjects.

A total of ten points is required.

Required Subjects.	Points.
Algebra A1,	1
Algebra A2,	1
English,	3
Plane Geometry,	1
History (American, Mediæval and Modern, or English),	1
Physics,	1
	8

Elective Subjects.	
English (additional year),	1
Elementary French (one year)	1
Elementary German (one year),	1
History (American, Mediæval and Modern, or English),	1

ENTRANCE EXAMINATIONS.

All students who are unable to present a certificate for either the degree or the diploma courses must pass entrance examinations. Notification of intention to take these examinations must be made in writing at least a week before the date of the examinations. These will be held as follows:—

Thursday, June 11, 1925; Thursday, September 17, 1925; Thursday, June 10, 1926:—
- Algebra, 9 A.M. to 11 A.M.
- History 11 A.M. to 1 P.M.
- English, 2 P.M. to 4 P.M.

Friday, June 12, 1925; Friday, September 18, 1925; Friday, June 11, 1926:—
- Plane Geometry, 9 A.M. to 11 A.M.
- German or French, 11 A.M. to 1 P.M.
- Physics, 2 P.M. to 4 P.M.

Candidates failing to pass the June examinations are allowed to try again in September; those who cannot attend the June examinations may present themselves in September.

REQUIRED SUBJECTS FOR ENTRANCE.

Algebra A1.—Fundamental operations, factoring, determination of the highest common factor and least common multiple, fractions, simple and complex, simple equations of one or more unknown quantities, problems involving linear equations of either numerical or literal quantities, radicals, involution and evolution, square and cube root, ratio and proportion, exponents including fractional and negative.

Algebra A2.—Quadratic equations both numerical and literal. Simple problems involving one or more unknown quantities that may be solved by the methods of linear or quadratic equations, binomial theorem for positive integral exponents, problems involving methods of arithmetical and geometrical progressions.

Plane Geometry.—The usual theorems and constructions of good textbooks, including the general properties of plane rectilinear figures, the circle and the measurement of angles, similar polygons, areas, regular polygons, and the measurement of the circle. The solution of original problems and problems in mensuration of lines and plane surfaces.

English.—As secondary schools are following to a greater extent than heretofore the requirements of the College Entrance Examination Board, it is recommended that the applicant to this school conform to the suggestions of this Board relative to English composition and literature.

The examination consists of two parts, both of which are given at the same time.

(*a*) With the object of testing the student's ability to express his thoughts in writing clearly and correctly he will be required to write upon subjects familiar to him. Emphasis will be laid upon the composition, punctuation, grammar, idiom and formation of paragraphs. He will be judged by how well he writes rather than by how much he writes.

(*b*) The second part of the examination is prepared with the view of ascertaining the extent of the student's knowledge of good literature, and to test this examination questions will be based on the books adopted by the National Conference on Uniform Entrance Requirements. Any course of equivalent amount if made up of standard works will be accepted.

Modern Languages.

Requirements for Degree Courses.

It is expected that the work in these subjects has covered a period of at least two years of preparatory school training or the equivalent. Importance should be given to the ability to translate into good idiomatic English, but attention should also be paid to grammar and construction, that greater care may be used in translation.

Elementary German A.—The entrance examination is composed of two parts, both taken, however, at the same time.

(*a*) Translation of simple German prose into good idiomatic English.

(b) Questions to test proficiency in grammar, and simple English sentences to be rendered into German.

The requirements include the declension of articles, adjectives, pronouns and nouns; the conjugation and inflection of weak and strong verbs; the simpler uses of the subjunctive; the use of the modal auxiliaries; the prepositions and their uses; the principal parts of important verbs; and the elementary rules of syntax and word order.

Texts used in the language courses of any reputable high or preparatory school will furnish reading for translation. A list of texts is offered by the College Entrance Examination Board.

Elementary French A.—The entrance examination is composed of two parts, both taken, however, at the same time.

(*a*) Translation of simple French prose into good idiomatic English.

(*b*) Questions to test proficiency in grammar, and simple English sentences to be rendered into French.

The requirements include the principal parts, conjugation and inflection

of the regular and the more common irregular verbs; the singular and plural forms of nouns and adjectives; the uses of articles and partitive construction; the forms and positions of personal pronouns; and the simpler uses of the conditional and subjunctive.

Suitable texts are suggested by the language courses of any reputable high or preparatory school and by the requirements of the College Entrance Examination Board.

Students who have pursued two years of elementary French as well as two years of elementary German may present one subject to cover two points in the required subjects, and the other to cover two points in the elective subjects.

History.

Applicants may offer a preparation of American history, English history or mediæval and modern history.

In American history applicants should be familiar with the early settlements in America, the colonies, their government, the customs of the people, and events which led to the establishment of the United States. They should be informed concerning the causes and effects of the principal wars in which the country has been involved. They should be prepared to consider also questions requiring an elementary knowledge of civil government, as well as historical facts connected with the growth of this country up to the present time.

For the subject of English history or mediæval and modern history the course given in any reputable secondary school should give proper preparation. A course extending over a full year with not less than three periods a week will be accepted.

Physics.

The applicant should be familiar with the fundamental principles of physics, particularly those considered under the headings of mechanics, heat, light, electricity and magnetism. Textbook instructions should be supplemented by lecture table experiments. Wherever possible, the student should pursue a laboratory course, but for the present no applicant will be conditioned in this subject if he has not been able to carry on a laboratory course. Where a laboratory course is offered by a secondary school, it should cover at least twenty-five of those experiments listed in the syllabus of the College Entrance Examination Board. An applicant should present his notebook, together with the certificate from the teacher under whom the work was performed.

ELECTIVE SUBJECTS.

History.—If the applicant can present all three or any two branches of history specified he may include one as a required subject and the others in the list of elective subjects.

Chemistry.—Applicants must show evidence of their familiarity with the rudiments of chemistry. Any course given in a secondary school organized to present instruction by means of textbook or lecture, together with correlated laboratory work, will be considered as covering the requirements. The applicant's notebook with his original notes, including description of experiments, apparatus used, reactions, observations and deductions, must be accompanied by his instructor's certificate.

Importance will be placed upon manipulation and deductions as well as the general appearance and neatness of the notebook.

Solid Geometry.—The usual theorems and constructions of good textbooks, including the relations of planes and lines in space, the properties and measurement of prisms, pyramids, cylinders and cones; the sphere and spherical triangles. The solution of original problems and the applications of the mensuration of surfaces and solids.

Trigonometry.—The usual courses of instruction covered by the standard textbooks on plane and spherical trigonometry will prepare an applicant sufficiently to meet this requirement.

Mechanical Drawing.—The applicant must have pursued such a course in mechanical drawing that he will be familiar with the usual geometrical construction problems, projection of points, lines, planes and simple solids.

Importance is laid not only upon the accuracy with which the work is performed, but upon the general arrangement, appearance and care with which the plates are executed.

It should not be understood that work in this subject may be offered as the equivalent of the first term's work at the school.

Mechanic Arts.—The usual courses offered by properly equipped preparatory schools will be accepted as suitable fulfillment of this requirement. Work should include instruction in the handling of both wood and metal working tools in the more simple practices of these arts.

Elementary French B.—Applicants who enter for one of the three-year courses may present one year's work in French in a secondary school. Those who present themselves for examinations in this subject should be familiar with the rudiments of grammar, and be able to translate simple French prose into good idiomatic English, also to translate into French English sentences, based on the French given for translation.

Elementary German B.—Applicants who enter for one of the three-year courses may present one year's work in German in a secondary school. What is stated in regard to French applies to those who may present German instead of French.

Advanced French or German.—In cases where applicants have pursued courses in French or German for more than two years, and have completed work which is more advanced than is included under elementary French or German, they may offer the additional year as an elective.

English.—In many secondary schools this subject is required during all of the four years, and where it is pursued to this extent the applicant may offer the additional year's work as one of his elective subjects.

Spanish.—Students offering Spanish should be familiar with elementary grammar, the common irregular verbs, and be able to translate simple Spanish to English or English to Spanish. A preparation equivalent to three periods per week for two years will be acceptable.

Latin.—Students who have pursued one or more years of Latin may present this subject as an elective. Each year's work satisfactorily completed will be considered equal to one point.

GENERAL INFORMATION

Preparation.—Particular stress should be laid upon a thorough grounding in mathematics, including algebra, arithmetic and plane geometry, as these form the basis upon which the work of this school rests. While solid geometry is not required at the present time, the student will find a knowledge of this subject very valuable in his subsequent work, and is strongly recommended to include this subject as one of his electives. A preliminary course in science, including physics, and chemistry, serves to prepare the student's mind for the higher branches of these subjects and their application, but neither will be considered as the equivalent of the courses in these branches given in the school.

Advanced Standing.—Candidates who may have received previous training in any of the subjects scheduled in the regular course will, upon presentation of acceptable certificates, be given credit for such work.

Registration.—All students are required to register on or before the Monday of the week beginning the school year, and again during the first week of the midyear examination period. For unexcused delay in registration a fee of $5 will be imposed.

Application Blanks.—A blank form of application for admission may be found at the end of this bulletin. This should be properly filled out by all applicants, whether entering upon certificate from a secondary school or presenting themselves for examination.

Fees.—The fee for the day course is $150 per year for residents of Massachusetts. For non-residents the fee for all courses is $200 per year. The fee for students from foreign countries is $300 per year.

Three-fifths of the fee is charged for a single term. Each term's tuition is payable during the first week of that term. Students failing to make this payment at the specified time will be excused from classes until satisfactory explanation and arrangements for payment can be made. *No bills will be sent.* After payment is made no fee or part thereof can be returned, except by special action of the trustees.

An athletic fee of $15 is due and payable at the time of the first payment of tuition.

Special students pay, in general, the full fee, but if a course be taken involving attendance at the school during a limited time, application may be made to the president for a reduction.

Students must provide their own books, stationery, tools, etc., and pay for any breakage or damage that they cause. The above fee includes free admission for any day students desiring to attend any of the evening classes in which there is accommodation.

For all first-year students a minimum deposit of $25 is required to cover the cost of breakage, supplies, and apparatus and chemicals used in the Chemical Laboratory, the unexpended balance to be returned to the student at the end of the year.

For all students in second, third and fourth years taking work in Chemistry and Dyeing Laboratories a deposit of $25 for the first term and $25 for the second term is required. Students taking Machine Shop will be required to make a deposit of $15 to cover cost of materials, supplies and breakage. Included in this charge is a kit of tools which is essential to the work and which becomes the personal property of the student. The unexpended balance will be returned at the end of the year.

All deposits must be made before students can be admitted for laboratory work.

Examinations.—For first-year students intermediate examinations are held every five weeks, and these serve to inform the student concerning his standing and the progress made.

For students in upper classes informal examinations will be held during the eighth week of each term.

Formal examinations are held at the end of each term.

In general, the examinations cover the work of the preceding term, but at the discretion of the instructor may include work of earlier terms.

Examinations for students conditioned in first-term subjects are held in June, and examinations for students conditioned in the second-term examinations are held in September following. Students requesting condition examinations at other than scheduled dates will be required to pay $5 for each examination so taken.

Any student who fails to complete a subject satisfactorily or to clear a condition at the time appointed, will be required to repeat or drop the subject, and he cannot be admitted to subjects dependent thereon.

A student whose term's standing is as a whole so low that he cannot continue with profit the work of the next term will be required to leave school, but he may return the following year to repeat such subjects as are required.

Daily work and regularity of attendance are considered in making up the reports of standing.

Continued or persistent absence or tardiness from the classes is considered reason to exclude a student from the class.

Records and Reports of Standing.—During each term informal reports are sent to parents or guardians of all students under age, and to all students; and at the end of each term formal reports are made.

The daily work of the student forms an important part of his record, and no pupil will be awarded the diploma or degree unless this portion of his record is clear.

Books are prescribed for study, for entry of lecture notes and other exercises, and are periodically examined by the lecturers. The care and accuracy with which these books are kept are considered in determining standing.

Attendance.—Attendance is required of all students on fourteen-fifteenths of all scheduled class exercises, provided they meet the requirements of their instructors for the omitted exercises. For every unexcused absence from any class exercise in excess of those allowed, a deduction from the mark obtained in the course in which the absences occurred will be made.

Advisors.—Advisors are appointed for all students, to be of such aid and assistance as they can both inside and outside of school hours. The head of the department in which a student is registered is advisor to upper classmen, and instructors in charge of freshman classes act as advisors to freshmen.

Thesis.—Each candidate for the degree of the school must file with the head of the department in which the thesis is taken, and not later than May 15, a report of original investigation or research, written on a good quality of paper, 8 by 10 inches, with 1-inch margin at left, and one-half inch at right, of each page; such thesis to have been previously approved by the head of the department in which it is made.

For all candidates for the diploma this requirement will be optional on the part of the school.

Graduate Course.—Graduates of technical courses of other schools are invited to communicate with the president with reference to special courses in the textile studies. Previous training in the sciences and the engineering branches will usually reduce materially the time necessary to complete any of the courses at this school. The advantages offered to such persons for special research work are unexcelled, and a most profitable course may be arranged.

Degrees.—The degree of Bachelor of Textile Engineering will be awarded for the completion of the four-year course in textile engineering. The degree of Bachelor of Textile Chemistry will be awarded for the completion of the four-year course in chemistry and textile coloring.

Diploma.—For the present the diploma of the school will be awarded upon the satisfactory completion of any one of the regular three-year courses. In cases where students obtain advanced standing, at least one year's attendance is required before the diploma can be obtained.

Conduct.—Students are required to return to the proper place all instruments or apparatus used in experimental work, and to leave clean and in working order all machinery and apparatus with which they may experiment. All breakages, accidents or irregularities of any kind must be reported immediately to the head of the department or instructor in charge.

In case of either day or evening students, irregular attendance, lack of punctuality, neglect of either school or home work, disorderly or ungentlemanly conduct or general insubordination are considered good and sufficient reasons for the immediate suspension of a student, and a report to the trustees for such action as they deem necessary to take.

It is the aim of the trustees so to administer the discipline of the school as to maintain a high standard of integrity and a scrupulous regard for trust. The attempt of any student to present, as his own, work which he has not performed, or to pass any examination by improper means, is regarded by the trustees as a most serious offence, and renders the offender liable to immediate suspension or expulsion. The aiding or abetting of a student in any dishonesty is also held to be a grave breach of discipline.

Any student who violates these provisions will be immediately suspended by the president, and the case reported at the following meeting of the trustees for action.

Library and Reading Room.—That the students may have surroundings conducive to reading and study a moderate-sized reading room with library tables and chairs has been provided. The library shelves contain textile, art, engineering and scientific publications. These are increased from time to time as new technical books of value to textile students are issued from the press. The leading textile papers are kept on file for ready reference.

Sessions.—The regular school sessions are in general from 8.45 A.M., to 12.45 P.M., and from 1.45 to 4.30 P.M., except Saturdays, when there is no session of the school. On Saturday afternoons the buildings are closed.

An hour plan designates the hours at which the various classes meet. This is rigidly adhered to, and the student is marked for his attendance and work as therein scheduled.

Residence and Expenses.—Students from a distance, requiring rooms and board in the city, may, if they desire, select the same from a list which is kept at the school. The cost of rooms and board in a good district is from $12 per week upwards.

All raw stock and yarn provided by the school, and all the productions of the school, remain, or become, the property of the school, except by special arrangement; but each student is allowed to retain specimens of yarn or fabrics that he has produced, if mounted and tabulated in accordance with the requirements of the school. It is understood that the school may retain such specimens of students' work as they may determine.

Lockers are provided for the use of the students, sufficiently capacious to contain clothing, books and tools.

No books, instruments or other property of the school are loaned to the students to be removed from the premises except by special permission.

Scholarships.—The Massachusetts Charitable Mechanics Association have offered two scholarships of $250 each which are for the purpose of defraying school expenses of such students who may be selected by a committee composed of a representative from the Association, one from the Board of Trustees and the President of the School.

Herbert A. Currier of the class of 1906 has offered a prize of $150 to a student who may be selected by the faculty of the school, and in making the selection the following conditions will be considered: scholastic standing, financial need, and ability in promoting student activities in school life. Scholarship to be available to some member of the sophomore, junior or senior classes.

Medals of Honor.—The National Cotton Manufacturers' Association offers annually a medal to that member of the graduating class who shall have during his course attained the highest standing in the special subjects required by the vote of the association.

Special Awards of Merit. Louis A. Olney Book Prize.

Prizes in the form of books are awarded each year to the successful candidates on graduation day. The conditions in detail are as follows:—

First.—Ten dollars to the student taking the regular Chemistry and Textile Coloring Course who shall be considered as having attained the highest scholarship in first-year chemistry.

Second.—Five dollars to the student taking the regular Chemistry and Textile Coloring Course who shall be considered as having attained the second highest scholarship in first-year chemistry.

Third.—Ten dollars to the regular student of the Chemistry and Textile Coloring Course who shall be considered as having attained the highest scholarship during his second year.

Fourth.—Five dollars to the regular student of the Chemistry and Textile Coloring Course who shall be considered as having attained the second highest scholarship during his second year.

Fifth.—Twenty dollars to the regular student in the Chemistry and Textile Coloring Course who shall present the best thesis preparatory to graduation.

The above-mentioned sums are to be invested in books which may be selected after graduation. In case no one is considered worthy of any particular scholarship prize, or if there is no competition, the same may be withheld. The decision in such case shall rest with the judges.

Edward A. Bigelow Prize.—Edward A. Bigelow, class of 1906, has offered the following cash prizes: $75 to the member of the graduating class from the Wool Manufacturing course who maintains the highest standing throughout his three years; $50 to the member of the second year class in the Wool

Manufacturing course who maintains the highest standing during his second year; $25 to the member of the first year class in the Wool Manufacturing course who maintains the highest standing during his first year.

Saco-Lowell Prize.—The Saco-Lowell Machine Shop of Lowell, Mass., offers a prize of $100 for the thesis prepared for graduation which will be considered of greatest value to the textile industry. Only candidates for a degree are eligible for this prize and the selection is to be made by a board comprised of three members, one from the Saco-Lowell Shops, one from the National Association of Cotton Manufacturers and one from the Lowell Textile School.

Textile Colorist Award.—The Textile Colorist, Inc., has offered a prize of $100 to be awarded to a member of the graduating class whose thesis, based upon his personal researches and experiences, is of the greatest practical value to the dyeing, bleaching or textile finishing industries.

Awards.—Gold medal, Paris Exposition, 1900, for general excellence. A special medal, Merchants and Manufacturers Exposition, Boston, 1900. The Pan-American medal, awarded to the school, 1901. Gold medal, Louisiana Purchase Exposition, 1904. Gold medal, Lewis and Clark Centennial Exposition, 1905. Medal of honor from Panama-Pacific International Exposition, 1915.

Bulletins and Catalogues.—All students registering and paying the regular fee for the course selected are entitled to the bulletins and catalogues when issued.

COURSES OF INSTRUCTION

Since its establishment the Lowell Textile School has offered courses, each of which extends over a three-year period. With the development of the school and close study of the problems presented to the graduates it has been found that attention should be given those branches of instruction which would give breadth of training as well as establish fundamental principles. This policy has resulted in extending the curriculum to such length that the need for an additional year's instruction was evident.

The fact was also appreciated that to carry on the more advanced work a better preparation must be demanded of the applicant for entrance.

Nevertheless, it was recognized that many young men seeking employment in the textile industry do not care, or are not in a position, to devote four years to scholastic preparation, and for these the regular three-year courses are offered.

These courses are designated as Cotton Manufacturing, Wool Manufacturing and Textile Design (General Textile Courses), the completion of any one of which the regular diploma of the school is awarded.

In general, it is assumed that students pursuing these courses will not take the advanced work of the fourth year. However, if a student electing one of the three-year courses desires to change to one of the four-year courses he may do so providing his preparation and undergraduate standing permit it.

The four-year courses are Textile Engineering, Chemistry and Textile Coloring. At the completion of these courses the degrees of Bachelor of Textile Engineering (B.T.E.) and Bachelor of Textile Chemistry (B.T.C.) are conferred.

Three options are offered in the Engineering Course, viz., general textile, cotton manufacturing or wool manufacturing. Each of these courses is planned to train one in the fundamental principles of science found to be applicable in the particular fields of textile chemistry and textile engineering. It is maintained that for one to be successful in either of these important branches of industry a training is required as thorough and broad as that of any of the recognized branches of engineering or of applied science.

With this in mind these courses have been built of a secure framework of science and mathematics, and to it has been added the useful application of these branches in the broad textile field. With the direct purpose of laying a secure foundation in the training, a more extended preparatory course is

first demanded, and subsequently in the school work more subjects of a general character are included, that narrowness of judgment and observation may not result by overstimulation of the technical development.

COURSES FOR WOMEN.

Although all classes are open to women, the courses which have appealed especially to their tastes have been textile designing and decorative art. Some have pursued courses in chemistry, and have added to their work in design some instruction in power weaving and finishing. These special courses have in general been followed for three years, and in some cases have led the students to positions either in the mill office or in some commercial lines that have been desirable and have offered congenial work.

Within the last few years the possibilities for women in certain branches of textile chemistry have become recognized, and it is believed that in the future the positions open to them will become more and more numerous.

GOVERNMENT POSITIONS.

One of the significant and important facts that has been clearly demonstrated during the recent conflict is the great value of a technical education. In no war has the applied science been so forcefully used as a weapon of combat.

An earlier catalogue pointed out the calls that the various departments of the government were making for graduates from this school in common with those of other technological institutions. The success attained by past students has been presented in a previous bulletin. As these men have shown their value to the government in times of war, so will they in times of peace. Before the war various departments of the government had found need for graduates from this textile school, and with the problems of peace the need undoubtedly will become greater.

The United States Civil Service Commission recognizes graduates from the degree courses of this school as proper applicants for the examination to the various positions requiring a knowledge of applied science and engineering, as well as a knowledge of textile manufacturing, in the different departments of the government.

COURSES.

In the column headed "Hours of Exercise" the numbers represent for each particular subject the total hours required in school for a period of fifteen weeks.

The letter and number which follow the subjects indicate the department in which the subject is given and the number of the subject in that department. For detailed description of the same, see page 28.

The departments are indicated as follows:—

Textile Engineering, B.
Chemistry and Dyeing, C.
Textile Design and Power Weaving, D.
Languages and History, E.
Cotton Yarns, F.
Woolen and Worsted Yarns, G.
Finishing, H.

By referring to the letter and number indicated under "Preparation" the student can ascertain what subjects are necessary in order that he may have a clear understanding of the subject which he is scheduled to take.

First Year. First Term. (Hours of Exercise.)

[Common to all courses.]

Mechanics B–3 (60 hrs.).
Mechanical Drawing B–7 (75 hrs.).
Mathematics B–1 (45 hrs.).
Textile Design D–1 (90 hrs.).
Elementary Chemistry C–1 (165 hrs.).
English E–1 (45 hrs.).
Physical Education (30 hrs.)

First Year. Second Term. (Hours of Exercise.)

Mechanism B–4 (Course VI-4—60 hrs.) (Course IV-4—60 hrs.).
Mechanical Drawing B–8 and B–9 (VI-4—90 hrs.) (Course IV-4—30 hrs.).
Mechanical Laboratory B–6 (Course VI-4—30 hrs.) (Course IV-4 ——hrs.).
Mathematics B–1 (Course VI-4—45 hrs.) (Course IV-4—45 hrs.).
Textile Design D–1 (Course VI-4—45 hrs.) (Course IV-4 ——hrs.).
Elementary Chemistry C–1 (Course VI-4—75 hrs.) (Course IV-4—75 hrs.).
Technology of Fibers F–1, G–1 and C–9 (Course VI-4—60 hrs.) (Course IV-4—60 hrs.).
English E–1 (Course VI-4—45 hrs.) (Course IV-4—45 hrs.).
Elementary German E–2 or Elementary French E–4 (Course VI-4—30 hrs.) (Course IV-4—30 hrs.).
Qualitative Analysis C–2 (Course VI-4 ——hrs) (Course IV-4—120 hrs.).
Stoichiometry C–3 (Course VI-4 ——hrs.) (Course IV-4—15 hrs.).
Physical Education (Course VI-4—30 hrs.) (Course IV-4—30 hrs.).

For second-term subjects in Courses I, II and III, see pages 16–21.

Course I.—Cotton Manufacturing.

The Cotton Manufacturing Course is designed for students contemplating a career in the manufacturing of cotton yarns and cloth or allied industries, and wishing to devote but three years to the school work.

During the first term the studies are common to all courses, and include instruction in mechanism, mathematics, mechanical drawing, textile design and elementary chemistry. Laboratory work supplements the lectures in chemistry, and weaving assists in illustrating the principles of textile design. At the commencement of the second term instruction in the preliminary processes of yarn manufacturing is given in the course of technology of fibers.

The work in the Cotton Yarn Department comprises instruction in all the manufacturing processes from the bale to the finished yarn. The instruction is given by means of lectures upon the machines and processes, and by laboratory work upon the machines themselves. In the laboratory each student is required to make exhaustive tests upon each machine, and to make as many settings and adjustments as possible. The third year's work in this department is largely devoted to lectures upon the manufacture of specialties, waste products, etc., and special laboratory work, special tests upon yarns and fabrics, mill planning with regard to the arrangement of machinery, and other work of an advanced nature.

The course in chemistry consists of lecture and laboratory work on inorganic and organic chemistry, followed by a lecture course of instruction in textile chemistry and dyeing.

The work in mechanism serves as a basis for all future machine and mechanical work, and is followed by steam engineering, electricity and mill engineering. The mechanical drawing taken in connection with these subjects augments this instruction as well as provides opportunity for students to become skilled in drafting.

The course in textile designing, cloth analysis and cloth construction includes lectures on plain and fancy weaves and Jacquard work, the analysis of all commercial fabrics, and designs for the same. During the third year of this course students in this department specialize on cotton fabrics.

Power weaving is taken up during the second and third years. Commencing with lectures and practice upon plain looms, the student is taken through dobby and box-loom weaving and Jacquards.

A course in knitting taken during the third year includes the manufacture of hosiery and underwear. The course on the finishing of cotton fabrics is given by lectures and laboratory work, and requires considerable work on standard machines in the laboratory.

For detailed description of the subject see page 28.

Finishing Department

Course I.—Cotton Manufacturing.

[For first term see page 14.]

First Year. Second Term. (Hours of Exercise.)

Mechanism B–4	60	Elementary Chemistry C–1	75
Mechanical Drawing B–8	90	English E–1	45
Mathematics B–1	45	Physical Education	30
Textile Design D–1	120		
Technology of Fibers F–1, G–1, C–9	60		

Second Year. First Term.

Cotton Yarn Mfg. F–2	210	Machine Drawing B–10	30
Textile Design D–2	90	Steam Engineering B–12	45
Power Weaving D–9	45	Physics B–11	45
Chemistry and Dyeing Lect. C–13	30	Industrial History E–6	15

Second Year. Second Term.

Cotton Yarn Mfg. F–2	195	Steam Engineering B–14	15
Textile Design D–2	60	Machine Drawing B–10	45
Power Weaving D–9	120	Physics B–11	45
Chemistry and Dyeing Lect. C–13	15	Industrial History E–6	15

Third Year. First Term.

Cotton Yarn Mfg. F–2	150	Cotton Finishing H–2	75
Knitting F–3	60	Electricity B–20a	30
Textile Testing G–3	15	Mill Engineering B–22	30
Power Weaving D–10	150		

Third Year. Second Term.

Cotton Yarn Mfg. F–2	180	Cotton Finishing H–2	75
Knitting F–3	60	Textile Testing G–3	15
Power Weaving D–10	180	Thesis.	

Course II.—Wool Manufacturing.

The course on wool manufacturing is arranged for those who contemplate a career in the manufacture of woolen or worsted fabrics, and can devote but three years to the school work. It includes instruction on all of the varied processes employed in manipulating the wool fiber to produce yarn and cloth, namely, sorting, scouring, carding, combing, spinning, designing, weaving, dyeing and finishing. The work is carried on by lectures, recitations and practical work in the laboratories.

Following the first term of the first year, which is common to all courses, the student in the course in technology of fibers is acquainted not only with the various kinds of wool and trade terms applied to them, but also with other commercial fibers, viz., cotton, silk, jute, hemp, flax, etc., used in the textile industry. He is at the same time taught the application of these fibers and the general processes of manufacturing each into a yarn.

Beginning with the second year the details of manipulating wool from the grease to the finished yarn is taken up for close study. This includes the spinning of woolen yarn, also worsted yarn, by both the English and the French systems. The intermediate processes of sorting, scouring, carding, combing and top-manufacturing are taken in detail and in proper sequence.

The general chemistry of the first year is followed by a lecture course in the second year on textile chemistry and dyeing.

Textile design, cloth analysis and construction are continued from the first year throughout the course, the work being applied especially to woolen and worsted goods. Weaving on power looms commences in the second year and continues through the third.

Lectures on finishing commence with the third year and are augmented by extensive practice with the machines in the Finishing Department.

Work in the Engineering Department extends throughout all three years, and includes mechanical drawing, steam engineering and electricity. The practical application of the principles studied in these subjects is brought out forcibly in the work on mill engineering, where mill design and construction are considered. A short course covering methods employed in the testing of fibers, yarns and cloths, together with laboratory work in the manipulation of certain physical apparatus, is given in the third year.

For detailed description of the subjects see page 28.

Course II.—Wool Manufacturing.

[For first term see page 14.]

First Year. Second Term. ((Hours of Exercise.)

Mechanism B–4	60	Elementary Chemistry C–1	75
Mechanical Drawing B–8	90	English E–1	45
Mathematics B–1	45	Physical Education	30
Textile Design D–1	120		
Technology of Fibers G–1, F–1, C–9	60		

Second Year. First Term.

Yarn Manufacture G–2	195	Machine Drawing B–10	30
Textile Design D–3	90	Steam Engineering B–12	45
Power Weaving D–9	60	Physics B–11	45
Chemistry and Dyeing Lect. C–13	30	Industrial History E–6	15

Second Year. Second Term.

Yarn Manufacture G–2	195	Steam Engineering B–14	15
Textile Design D–3	60	Machine Drawing B–10	45
Power Weaving D–9	120	Physics B–11	45
Chemistry and Dyeing Lect. C–13	15	Industrial History E–6	15

Third Year. First Term.

Yarn Manufacture G–2	180	Electricity B–20a	30
Knitting F–3	60	Mill Engineering B–22	30
Power Weaving D–10	120	Textile Testing G–3	15
Finishing H–1	75		

Third Year. Second Term.

Yarn Manufacture G–2	180	Power Weaving D–10	180
Knitting F–3	60	Finishing H–1	75
Textile Testing G–3	15	Thesis.	

Course III.—Textile Design.

The general course in textile design is planned to meet the demand of young men for a technical training in the general processes of textile manufacturing, but with particular reference to the design and construction of fabrics. To this end a foundation is laid in the first year by instruction in the elementary principles of designing, decorative art and weaving. That he may later in the course pursue to advantage instruction in yarn manufacturing, weaving, dyeing, finishing and some engineering problems, a foundation course in mechanics, mathematics and chemistry is laid. As the student is required to pursue courses in the yarn departments, both cotton and wool, he acquires a knowledge of the manufacture of cotton yarns from the bale to the yarn, and of woolen and worsted yarns from the fleece through the varied processes of manufacturing woolen yarn or worsted yarn by both the French and Bradford systems.

Throughout his entire course he receives instruction in design, cloth analysis and construction of all the standard cloths, viz., trouserings, coatings, suitings, blankets, velvets, corduroys, plushes, etc. This is followed by advanced work in Jacquard designing and weaving, which serves not only to acquaint the student with the many kinds of cotton, woolen, worsted and silk fabrics of figured design, but stimulates and develops any artistic talent he may possess. Decorative art becomes an important part of the work of the second and third years.

The course in general inorganic and organic chemistry of the first year leads to the subject of textile chemistry and dyeing in the second year.

Power weaving commences with the second year and continues throughout the course, and work on all types of looms is required.

During the third year the student receives instruction in the finishing of cotton goods and woolen and worsted cloths. This instruction is given by means of lecture and laboratory work.

The engineering subjects given in the second and third years are intended to acquaint the student with such general knowledge as will be of assistance should he be called upon in later life to be a mill manager, or should his subsequent progress lead to some executive position in the operation of a textile plant.

For detailed description of the subjects see page 28.

Course III.—Textile Design.

[For first term see page 14.]

First Year. Second Term. (Hours of Exercise.)

Mechanism B–4	60	Tech. of Fibers F–1, G–1 and C–9	60
Mechanical Drawing B–8	90	Elementary Chemistry C–1	75
Mathematics B–1	45	English E–1	45
Textile Design D–1	120	Physical Education	30

Second Year. First Term.

Design, Decorative Art D–1, 2, 3	150	Machine Drawing B–10	30
Cotton Yarn Mfg. F–1	150	Steam Engineering B–12	45
Power Weaving D–9	45	Physics B–11	45
Chemistry and Dyeing Lect. C–13	30	Industrial History E–6	15

Second Year. Second Term.

Design, Decorative Art D–1, 2, 3	120	Wool Yarns G–2	135
Cotton Yarn Mfg. F–2	75	Steam Engineering B–14	15
Power Weaving D–9	45	Physics B–11	45
Chemistry and Dyeing Lect. C–13	15	Industrial History E–6	15
		Machine Drawing B–10	45

Third Year. First Term.

Design, Cloth Construction, Decorative Art D–6, 7, 8	60	Power Weaving D–10	75
Wool Yarns, G–2	90	Wool Finishing H–1	75
Mill Engineering B–22	30	Cotton Finishing H–2	75
Knitting F–3	60	Electricity B–20a	30
		Textile Testing G–3	15

Third Year. Second Term.

Design, Cloth Construction, Decorative Art D–6, 7, 8	120	Wool Finishing H–1	75
Wool Yarns G–2	105	Cotton Finishing H–2	75
Knitting F–3	15	Thesis.	
Power Weaving D–10	105	Textile Testing G–3	15

Course IV. Chemistry and Textile Coloring.

The four-year Course in Chemistry and Textile Coloring, leading to the degree of B.T.C., is especially intended for those who wish to engage in any branch of textile chemistry, textile coloring, bleaching, finishing or the manufacture and sale of the dyestuffs or chemicals used in the textile industry. The theory and practice of all branches of dyeing, printing, bleaching, scouring and finishing are taught by lecture work supplemented by a large amount of experimental laboratory work and actual practice in the dyehouse and finishing room.

The underlying theories and principles of chemistry are the same, no matter to what industry the application is eventually made. Furthermore, no industry involves more advanced and varied applications of the science of chemistry than those of the manufacture and application of the coal-tar coloring matters. In addition, the textile colorist must consider the complex composition of the textile fibers, and the obscure reactions which take place between them and the other materials of the textile industry.

During the first year general chemistry, including both inorganic and organic, is taught by lectures and laboratory work, and this is supplemented during the second term by qualitative analysis and stoichiometry.

Advanced inorganic chemistry, as well as advanced organic chemistry, is studied during the second and third year as a continuation of the elementary chemistry of the first year, and much time is spent upon quantitative analysis, industrial chemistry, and textile chemistry and dyeing.

The foundation work in general chemistry is continued during the third year with courses in physical chemistry, organic laboratory work and analytical work. The subject of industrial chemistry is introduced, and much time is devoted to advanced textile chemistry, dye testing, color matching, calico printing and woolen, worsted and cotton finishing.

The fourth year is characterized by an endeavor to present certain subjects of a more applied nature in such a manner that the student's reasoning power and ability to apply the knowledge gained during the first three years may be developed to the fullest extent. The subject of engineering chemistry is introduced, and the work in the Dyeing and Analytical Laboratories is applied as far as possible to the actual requirements of the factory chemist and colorist. The student is given a thorough course in microscopy, photomicrography and the use of the various instruments, such as the spectroscope, ultra-microscope, polariscope, tintometer, etc., which often prove of vital importance in the advanced study of textile chemistry. During this fourth year the student devotes much time in the Organic Laboratory in the manufacture of dyestuffs. This is followed by some research work or original investigation as time will permit. Upon this he must present a satisfactory thesis, or report, before receiving his degree.

For detailed description of the subjects see page 28.

Course IV.—Chemistry and Textile Coloring.

[For first year see page 14.]

Second Year. First Term. (Hours of Exercise.)

Adv. Inorganic Chemistry C–4	30	Quantitative Analysis C–6	195
Textile Chemistry and Dyeing Lect. C–13	30	Steam Engineering B–12	45
Chemistry and Dyeing Lab. C–10	75	Physics B–11	45
Stoichiometry C–3	15	Industrial History E–6	15
		Advanced German E–3	30
		Mathematics B–2	45

Second Year. Second Term.

Adv. Inorganic Chemistry C–4	30	Quantitative Analysis C–6	135
Chemistry and Dyeing Lect. C–13	15	Adv. Organic Chemistry C–5	30
Chemistry and Dyeing Lab. C–10	135	Physics B–11	45
Stoichiometry C–3	15	Industrial History E–6	15
Mathematics B–2	45	Advanced German E–3	30
		Steam Engineering B–14	15

Third Year. First Term

Adv. Textile Chemistry and Dyeing Lect. C–14	30	Adv. Organic Chemistry Lect. C–5	30
Adv. Textile Chemistry and Dyeing Lab. C–14	135	Technical German C–21	30
Industrial Chemistry C–12	30	Wool Finishing H–1	75
Quantitative Analysis C–7	165	Economics E–7	30

Third Year. Second Term.

Adv. Textile Chemistry and Dyeing Lect. C–14	15	Physical Chemistry C–8	30
Adv. Textile Chemistry and Dyeing Lab. C–14	75	Technical German C–21	30
Industrial Chemistry C–12	30	Organic Laboratory C–15	105
Wool Finishing H–1	75	Quantitative Analysis C–7	120
		Economics E–7	30

Fourth Year. First Term.

Physical Chemistry C–8	45	Quantitative Analysis C–17	15
Technical German C–21	15	Dyeing Laboratory C–14	150
Engineering Chemistry C–16	15	Organic Laboratory C–15	90
Adv. Textile Chemistry and Dyeing C–14	30	Industrial Laboratory C–13	45
Textile Testing G–3	15	Thesis C–22	90

Fourth Year. Second Term.

Organic Laboratory C–15	105	Adv. Dyeing Conference C–19	15
Microscopy C–18	45	Technical German C–21	30
Dyeing Laboratory C–14	90	Engineering Chemistry C–16	75
Textile Testing G–3	15	Thesis C–22	135

Course VI.—Textile Engineering.

This course is the four-year general textile course leading to the degree of Bachelor of Textile Engineering (B.T.E.), and aims especially to fit men, in the broadest possible manner, to meet the increasing demands of every branch of the textile industry for men with combined textile and technical preparation. The magnitude and scope of the textile and allied industries fully justify the most thorough technical training possible for all who aspire to leadership in this field.

The student is first thoroughly grounded in those fundamental principles of science upon which all industrial and engineering work rests. The foundation of his textile and technical training is in the subjects of mathematics, physics, chemistry, drawing, mechanics, mechanism, and technology of fibers, and their practical application.

Instruction is given in all of the various branches of textile manufacturing through lectures, recitations and laboratory work. A large proportion of his time is spent in well-equipped textile departments where he studies and operates all of the machinery required in the conversion of cotton and wool fiber into yarns and fabrics. This includes cotton, wool and worsted yarn manufacturing, designing, weaving, knitting, dyeing and finishing. In his last year the course in textile testing acquaints the student with the methods for determining the physical properties of textile fibers, yarns and fabrics.

To properly equip the student to meet the varied engineering problems which confront the mill manager or executive, or to so train him that he may enter those industries closely allied to the textile instruction is given by lecture and laboratory practice in the several branches of engineering.

Steam engineering considers the problems involved in steam generation and distribution for power, heating and manufacturing purposes, includes the testing of laboratory and power plant equipment, and leads to the design of power plants. The course in electrical engineering includes a study of the generation and transmission of electrical power, the testing of direct and alternating current machinery, and is intended to acquaint the student with modern practice.

Mill engineering familiarizes the student with mill design, construction, heating, lighting, humidification and fire protection. The arrangement of machinery and buildings for most efficient production and economical power distribution is also studied in detail.

During the fourth year the student is required to conduct an original investigation of some textile or allied problem, and to submit the results in the form of a satisfactory thesis before receiving his degree.

The broadening effect of such subjects as English, language, industrial history and economics is carried still further in this course by carefully planned courses in business administration, accounting, cost accounting, business and patent law.

For the student who may desire the breadth of technical training which this course offers, but who wishes to specialize in either cotton or wool manufacturing, two options are offered. In these optional courses the student's entire textile time is devoted to the study of that particular fiber which he elects.

For detailed description of subjects, see page 28.

Course VI.—Textile Engineering (General Course.)

[For first year see page 14.]

Second Year. First Term. (Hours of Exercise.)

Chemistry and Dyeing Lect. C–13	30	Engineering Lab. B–16	45
Physics B–11	45	Machine Shop Practice B–17	45
Mathematics B–2	45	Cotton Yarn Mfg. F–1	45
Machine Drawing B–10	60	Wool Yarn Mfg. G–1	90
Steam Engineering B–12	45	Language E–3, 5	30
Power Weaving D–9	30	Industrial History E–6	15

Second Year. Second Term.

Physics B–11	45	Industrial History E–6	15
Mathematics B–2	45	Power Weaving D–9	30
Machine Drawing B–10	75	Chemistry and Dyeing Lect. C–13	15
Steam Engineering B–13	30	Graphic Statics B–5	30
Machine Shop Practice B–17	45	Engineering Lab. B–16	45
Yarn Mfg. F–2 and G–2	105		
Language E–3, 5	30		

Third Year. First Term.

Electrical Engineering B–20	75	Power Weaving D–10	45
Machine Shop Practice B–17	45	Mathematics B–2	30
Engineering Lab. B–16	45	Mill Engineering B–21	45
Yarn Mfg. F–2 and G–2	90	Wool Finishing H–1	75
Strength and Materials B–18	30	Economics E–7	30

Third Year. Second Term.

Hydraulics B–15	15	Wool Finishing H–1	75
Electrical Engineering B–20	75	Power Weaving D–10	45
Mill Engineering B–21	45	Mathematics B–2	30
Machine Shop Practice B–17	30	Strength of Materials B–18	30
Yarn Mfg. F–2 and G–2	135	Economics E–7	30

Fourth Year. First Term.

Yarn Mfg. and Knitting F–2, 3 and G–2	135	Power Plants B–19	30
Mill Engineering B–23	75	Business Administration B–24	45
Electrical Engineering B–20	75	Elements of Accounting B–25	45
Cotton Finishing H–2	30	Thesis	45
Textile Testing G–3	15	Electives B–28	
		Knitting F–3	15

Fourth Year. Second Term.

Yarn Mfg. and Knitting F–2, 3 and G–2	75	Business Administration B–24	30
Mill Engineering B–23	75	Cost Accounting B–26	45
Electrical Engineering B–20	75	Business Law B–27	15
Cotton Finishing H–2	75	Thesis	60
Power Plants B–19	30	Electives B–28.	
		Knitting F–3	60

Course VI.—Textile Engineering (Cotton Option).

[For first year see page 14.]

Second Year. First Term. (Hours of Exercise.)

Chemistry and Dyeing Lect. C–13	30	Steam Engineering B–12	45
Physics B–11	45	Machine Shop Practice B–17	45
Mathematics B–2	45	Cotton Yarn Mfg. F–1	135
Machine Drawing B–10	60	Language E–3, 5	30
Engineering Lab. B–16	45	Industrial History E–6	15
		Power Weaving D–9	30

Second Year. Second Term.

Physics B–11	45	Power Weaving D–9	30
Mathematics B–2	45	Language E–3, 5	30
Machine Drawing B–10	75	Industrial History E–6	15
Steam Engineering B–13	30	Chemistry and Dyeing Lect. C–13	15
Machine Shop Practice B–17	45	Graphic Statics B–5	30
Yarn Mfg. F–2	105		
Engineering Lab. B–16	45		

Third Year. First Term.

Electrical Engineering B–20	75	Engineering Lab. B–16	45
Mill Engineering B–21	45	Mathematics B–2	30
Yarn Mfg. F–2	75	Strength of Materials B–18	30
Cotton Design D 6, 7	75	Economics E–7	30
Power Weaving D–10	30	Cotton Finishing H–2	75

Third Year. Second Term.

Hydraulics B–15	15	Power Weaving D–10	60
Electrical Engineering B–20	75	Mathematics B–2	30
Mill Engineering B–21	45	Strength of Materials B–18	30
Yarn Mfg. F–2	90	Economics E–7	30
Cotton Design D–6, 7	60	Cotton Finishing H–2	75

Fourth Year. First Term.

Mill Engineering B–23	90	Business Administration B–24	45
Electrical Engineering B–20	30	Elements of Accounting B–25	45
Yarn Mfg. F–2	90	Electives B–28.	
Power Plants B–19	30	Knitting F–3	60
Textile Testing G–3	15	Thesis	75
Textile Design D–7	30		

Fourth Year. Second Term.

Yarn Mfg. F–2	120	Cost Accounting B–26	45
Mill Engineering B–23	75	Business Law B–27	15
Electrical Engineering B–20	60	Electives B–28.	
Power Plants B–19	30	Knitting F–3	60
Business Administration B–24	30	Thesis	45
Textile Design D–7	30		

Course VI.—Textile Engineering (Wool Option).

[For first year see page 14.]

SECOND YEAR. FIRST TERM. (HOURS OF EXERCISE.)

Chemistry and Dyeing Lect. C–13	30	Steam Engineering B–12	45
Physics B–11	45	Machine Shop Practice B–17	45
Mathematics B–2	45	Yarn Manufacture G–1	135
Machine Drawing B–10	60	Language E–3, 5	30
Engineering Lab. B–16	45	Industrial History E–6	15
		Power Weaving D–9	30

SECOND YEAR. SECOND TERM.

Physics B–11	45	Power Weaving D–9	30
Mathematics B–2	45	Language E–3, 5	30
Machine Drawing B–10	90	Industrial History E–6	15
Steam Engineering B–13	30	Chemistry and Dyeing Lect. C–13	15
Machine Shop Practice B–17	45	Graphic Statics B–5	30
Yarn Manufacture G–2	105		
Engineering Lab. B–16	45		

THIRD YEAR. FIRST TERM.

Electrical Engineering B–20	75	Power Weaving D–10	45
Machine Shop Practice B–17	45	Engineering Lab. B–16	45
Mathematics B–2	30	Strength of Materials B–18	30
Mill Engineering B–21	45	Economics E–7	30
Yarn Manufacture G–2	90		
Woolen and Worsted Finishing H–1	75		

THIRD YEAR. SECOND TERM.

Hydraulics B–15	15	Woolen and Worsted Finishing H–1	75
Electrical Engineering B–20	75	Power Weaving D–10	90
Mill Engineering B–21	45	Mathematics B–2	30
Machine Shop Practice B–17	30	Strength of Materials B–18	30
Economics E–7	30		
Yarn Manufacture G–2	90		

FOURTH YEAR. FIRST TERM.

Mill Engineering B–23	90	Textile Testing G–3	15
Electrical Engineering B–20	30	Business Administration B–24	45
Worsted Yarn Manufacture G–2	135	Elements of Accounting B–25	45
Woolen and Worsted Design D–6, 7	45	Power Plants B–19	30
		Thesis	75

FOURTH YEAR. SECOND TERM.

Mill Engineering B–23	75	Cost Accounting B–26	45
Electrical Engineering B–20	75	Business Law B–27	15
Worsted Yarn Manufacture G–2	60	Power Plants B–19	30
Woolen and Worsted Design D–6, 7	30	Thesis	90
Business Administration B–24	30	Electives B–28	
		Knitting F–3	60

SUBJECTS OF INSTRUCTION.

TEXTILE ENGINEERING DEPARTMENT—B.

Mathematics (Algebra, Trigonometry, Elements of Analytical Geometry)—B-1. Preparation: Admission Requirements. This subject is given in the first year with a view of consolidating the separate branches of mathematics that have been given in previous years. The progress of the school has been such as to necessitate the introduction of higher algebra and trigonometry in the early part of the first term, and hence, as in other technical schools, it has resulted in a combined course. This course is presented by means of lectures, textbook, class and problem work, and consists essentially of the following: graphical representation, logarithms, slide rule, trigonometry, theory of equations, significant figures, and plotting of scientific data, straight line equations, equation of parallel and perpendicular lines, equations of the conic sections. [All courses.]

Mathematics (Analytical Geometry, Differential Calculus, Integral Calculus)—B-2. Preparation: B-1. This course is a continuation of the work of the first year, and treats of the following subjects: formulæ of differentiation, conic sections, transformation of co-ordinates, maxima and minima, direction of curves, center and radius of curvature, problems on differential calculus, elements of integral calculus, integration as a summation, and plane areas. The above are treated in both rectangular and polar co-ordinates. Then follow formulæ of integration, integration by parts, integration by substitution, successive integration, evaluation of integrals, center of gravity, center of pressure, total pressure, moment of inertia. [Courses IV, VI.]

Mechanics—B-3. Preparation: Admission Requirements. Taken simultaneously with B-1. This subject is required as a necessary preparation for all courses, and sixty hours of lecture and recitation time are devoted to it during the first term of the first year. The fundamental principles of this subject are considered absolutely essential to a thorough understanding of the operation of all machinery, textile or otherwise. Some of the topics treated in this course are linear and angular velocity, uniform and accelerated motion, mass, momentum, inertia, effect of force in producing motion, centrifugal force, work, power, energy, principle of moments and its applications, parallelogram and triangle of forces with applications, resolution and composition of forces, the mechanical principles represented by the wheel and axle, differential pulley block, common pulley blocks, jackscrew, worm and wheel, and inclined plane. [All courses.]

Mechanism—B-4. Preparation: B-1 and B-3. This subject is also deemed to be one of those absolutely essential to every student's preparation for the work of the following years, and sixty hours during the second term of the first year are allowed for it. Whereas the principles studied are of general application, textile machinery in particular furnishes an unusually large variety of specific examples, and frequent reference is made to these in the development of the course. Some of the important topics covered are gearing and gear train design, belting and pulley calculations, cone and stepped pulley design, cam design, linkages, epicyclic gear trains, and intermittent motion devices. [All courses.]

Graphic Statics—B-5. Preparation: B-1 and B-3. The work in this course is presented by lecture and recitations. First are considered mathematical and graphical conditions for equilibrium for any system of forces, and the subjects of center of gravity and funicular polygons are introduced. Then follow problems on bridge and roof trusses under various conditions of dead, live, wind and snow loading. [Course VI.]

Mechanical Laboratory—B-6. Preparation: B-1 and B-3. Taken simultaneously with B-4. This work is given during the second term of the first year, and is supplementary to the course in Mechanics and Mechanisms. Especial importance is attached to the demonstration of the fundamental

principles of these subjects. Some of the experiments and tests made in this course are as follows:—

Determination of coefficient of friction; proof of principle of moments; proof of principle of work; efficiency test of various hoisting and lifting appliances, such as tackle and fall, worm block, differential and triplex blocks, jackscrews, wedges, etc.; experimental proofs of the principles of graphic statics; efficiency tests on belt transmission, including measurement of belt tensions, coefficient of friction, slip, etc.

Tests on various types of absorption dynamometers; calibration of transmission dynamometer; power measurements on textile machinery with differential dynamometer; measurement of friction of steam engine. [Course VI.]

Mechanical Drawing—B–7. Preparation: Admission Requirements. Taken simultaneously with B–3. This course is taken during the first year, and consists of work in the drawing room supplemented by lectures. This subject is considered of the greatest importance as a preparation for the student's future work, and the practical usefulness of drawing of this character is fully emphasized. The course is systematically laid out covering in order the following divisions:—

Care and use of drawing instruments; geometrical constructions; elements of projections and descriptive geometry; isometric projection; developments with practical applications; sketching practice on machine details. [All courses.]

Machine Drawing—B–8. Preparation: B–7. This work is the continuation of Mechanical Drawing, and is pursued throughout the second term of the first year. This work is wholly of a practical character, and includes sketching from the textile machinery details, working scale detail and assembly drawing, tracing and blue printing. The rudiments of machine design to supplement the work in strength of materials is also given. [Courses I, II, III, VI.]

Machine Drawing—B–9. Preparation: B–7. For students electing the Chemistry and Textile Coloring course in the second term of the first year a course of machine drawing is given similar to B–8, except that it is not as extensive and is concluded in thirty hours. [Course IV.]

Machine Drawing—B–10. Preparation: B–4, B–7, B–8. During the second year the work in Machine Drawing is devoted to advanced graphical mechanism problems. The data for all of these problems are in every case taken directly from some of the textile machines that the students meet in other departments. These problems include cam designs for builder motions, mule scroll layouts, Scaife builder motion analysis, fly frame cone design, mule quadrant motion, analysis of camless winder, and a number of others of similar character. [Courses I, II, III, VI.]

Physics—B–11. Preparation: B–1 and B–3. This course is given during the second year, and serves especially as a preparation for hydraulics, electricity and optics. The subject is presented by means of lectures, recitations, problems and reference books. The lectures deal chiefly with the application of the various physical laws and principles, with a view to their adaption to the above subjects, while the reference books are used to supplement the lectures. The subjects taken up are essentially as follows: gravitation, moving bodies, mechanics, elasticity, hydrostatics, elements of hydraulics, properties of fluids and gases, and the theory of sound. These subjects are followed by a series of lectures on heat phenomena, dealing with the generation of heat, thermometry, calorimetry, transfer of heat, its effect on solids, liquids and gases.

The latter part of the course is devoted to the discussion of the laws governing the nature, propagation and transmission of light waves, special stress being laid on interference, reflection and refraction, mirrors, lenses, microscope, spectroscope and photometer. Particular attention is given to the color effects produced by the combination of different colors in connection with Maxwell's Color Diagram and the Young-Helmholtz Theory of Color Sensation. During the last part of the course the principles of electricity and magnetism are taken up in detail. [All courses.]

Steam Engineering — B–12. Preparation: B–1, B–3, B–4. The purpose of this course is to familiarize the student with the principles of elementary thermodynamics, the properties of steam, mechanical mixtures, combustion of fuels, types of boilers, and the auxiliaries of the modern boiler house. The course consists of forty-five exercises given in the first term of the second year. The lectures and recitations are supplemented with illustrative problems assigned for home preparation. [All courses.]

Steam Engineering — B–13. Preparation: B–12. This course is a continuation of B–12, and consists of thirty hours of lectures and recitations given in the second term of the second year of the Textile Engineering course. The subjects developed are the kinematics of reciprocating steam engines, steam turbines and gas engines. Special attention is given to the mechanical principles on which the steam engine operates, with detail discussion of the valve gear and governing devices, and the various diagrams used for studying the same. Consideration is given to the underlying heat theory and to the details of construction of the various parts of the machines. During the latter part of the course the historical development, classification and types of turbines and gas engines are discussed. [Course VI.]

Steam Engineering — B–14. Preparation: B–12. This course consists of fifteen lectures and is supplementary to Course B–12. Its aim is to give those students who do not take the Engineering course a general knowledge of the steam engine, steam turbine and gas engine, and their auxiliaries. One exercise is devoted to an engine test to demonstrate the practical use of the indicator and the advantages of condensing. [Courses I, II, III, IV.]

Hydraulics — B–15. Preparation: B–2 and B–11. This subject is presented by means of lectures covering the principles of hydraulics, including hydrostatics, measurements of flow of water through orifices, pipes, nozzles and over weirs. The different types of turbines are studied with results of tests and rating tables. [Course VI.]

Engineering Laboratory — B–16. Preparation: B–12. The principles underlying the subjects of steam engineering, hydraulics and thermodynamics are demonstrated in a practical manner in the work in the Engineering Laboratory. Greater importance is attached to the development of initiative and responsibility in the student than the mere accomplishment of a large number of carefully planned tests. The character of this work is indicated by the following list of experiments and tests:—

Calibration of guages, thermometers, indicators, anemometers, tachometers and other measuring instruments; experiments on flow of steam; calorimeter tests; radiation tests and pipe-covering tests; injector and ejector tests; engine tests, condensing and non-condensing; steam pump tests; surface condenser tests; valve setting; boiler testing; tests on heating and ventilating fans, both motor and engine driven; pump tests, triplex and centrifugal; air-compressor tests; flue gas analysis; steam turbine tests; condensing, non-condensing and low pressure; complete steam plant testing; gas engine testing. [Course VI.]

Machine Shop Practice — B–17. Preparation B–3 and B–4. Systematic instruction is given in the most approved methods of machine shop practice, the object being to familiarize the student with the proper use of hand and machine tools, and the characteristics of the different materials worked. Particular attention is given to the form, setting, grinding and tempering of tools and the mechanism of the different machines involving certain speeds, feeds, etc. The course is so planned that the instruction in each typical operation shall conform as nearly as possible to commercial machine-shop practice on textile machinery. The list of tools which appears under "Equipment" in this Bulletin gives an idea of the scope of the work, which includes chipping and filing, tool grinding and tempering, straight and taper turning, screw cutting, drilling and boring, planer work; milling machine work, including gear cutting. Instruction is also given in the use of woodworking tools, both hand and machine, and in forging. [Course VI.]

Strength of Materials — B–18. Preparation: B–2, B–4, B–5. This subject consists of sixty exercises given in the third year of the Textile Engineering

course, and in which are discussed, as fully as time permits, such topics as stress, strain, methods of testing materials, bending moments, shearing force, beam design, column design, torsion, design of shafts, compound beams and columns, combined stresses, etc. The subject is preparatory to the work in Mill Engineering of both the third and fourth years, where its practical value and application are clearly demonstrated. [Course VI.]

Power Plants — B–19. Preparation: B–13. This course, which consists of lectures given during the fourth year, takes up the fundamental consideration involved in the planning of a power plant for a textile mill. A standard textbook is used in connection with the lectures, and the problems are taken largely from plans of existing modern plants. The choice of type and size of units for certain conditions are given particular attention. [Course VI.]

Electrical Engineering — B–20. Preparation: B–11. The elementary principles of electricity and magnetism are considered in the lecture course of physics. Their development and application are taken up in this course in a detailed study of the means used to generate, transmit and transform electrical energy to meet the requirements of textile machinery and plants. This involves the theory of direct and alternating current generators, motors, instruments, as well as the various phenomena associated with them.

The laboratory course includes a study of instruments and methods employed in general electrical power testing. Attention is given to various lighting units, their particular properties and relative values in meeting the special problems of illumination in textile mills. [Course VI.]

Electricity — B–20a. Preparation: B–11. This is a short course given in the third year of the manufacturing courses, and consists of thirty lectures covering briefly and in a general way the theory of direct and alternating current generators and motors. [Courses I, II, III.]

Mill Engineering — B–21. Preparation: B–2, B–4, B–5, B–10, B–18. Mill Engineering, as presented in thirty lectures during the third year of the Textile Engineering course, consists of a discussion of the following topics: the selection of a site for a manufacturing plant; the exploration of the subsoils for the footing course of the foundation; wood, concrete and sheet steel piling; design of walls, columns, beams, floors, windows, doors, stairways and roofs.

Sixty hours of drawing room and laboratory practice are devoted to plane surveying, contour plotting, cut and fill calculations, setting of batter boards, alignment of shafting and the study from blue prints of mills of slow-burning construction. [Course VI.]

Mill Engineering — B–22. Preparation: B–1, B–4, B–10. Mill Engineering, as presented in thirty lectures during the third year of the diploma courses, is largely general in its nature and includes only parts of Course B–21. [Courses I, II, III.]

Mill Engineering — B–23. Preparation: B–3, B–4, B–10, B–17. This work, given in the fourth year of the Textile Engineering course, covers a wide range of subjects and is of the most practical character possible. All of the student's previous work in engineering and his knowledge of the textile processes are here brought together in the consideration of the larger problems of mill design, construction and organization. After a detailed study has been made of the most modern types of mill buildings, including all calculations and drawings, the student is given the problem of laying out and completely designing a textile mill so far as time permits.

The modern methods of power transmission and the proper arrangement of textile machinery are also given careful consideration. The problems are in every case taken from actual conditions in mills already built or in process of construction. The question of mill heating, ventilation, lighting, humidification and fire protection is also studied, and the time spent in the drawing room enables the student to work out nearly all of the more important problems involved in the design of an entire textile mill plant. The close relation existing between proper plant design and economical production is also considered. [Course VI.]

Business Administration—B–24. Preparation: B–1 and E-7. In recognition of the great advances which have been recently made towards better methods of management, and of the possibilities which may result from its application to the textile industry, a course in business administration has been established to enable the student to understand and apply the principles and details of modern management. The instruction in this course begins with a consideration of the factory location and design and their effect on efficiency of production, after which the proper form of organization for manufacturing establishments is discussed in detail, together with organization charts and records.

This is followed by a study of the details of the work of the various departments, such as purchasing, manufacturing, planning, etc., and includes such topics as purchasing systems, storeskeeping, perpetual inventories, warehousing, scheduling, routing, tracing, timekeeping, motion studies, time studies, mnemonic symbolizing, graphical records, wage systems, etc. Consideration is also given to the important relation of psychology to efficient management. The work is further supplemented by visits to plants where methods of production and management can be observed at first hand by the students. [Course VI.]

Elements of Accounting—B–25. Preparation: B–1 and E–7. The purpose of the course in accounting is to acquaint the student with modern methods of accounting for mercantile and manufacturing businesses. At the same time it gives him a much-needed knowledge of such common elementary business transactions as are involved in the use of checks, drafts, notes, vouchers, bonds and stocks.

It is not the purpose of the course to make the student a proficient bookkeeper or accountant, but the nature of the work necessitates a basic knowledge of double-entry bookkeeping and of the functions of ledger accounts. This is developed in practice in the following manner: During the summer preceding the fourth year the student is required to work up a simple bookkeeping set, thus saving valuable time during the school year and effectively preparing the ground for the instruction work.

The course includes a study of the balance sheet and profit and loss statement, and their construction in proper form. Attention is given to the principles of balance sheet valuation, and to such topics as depreciation in all its phases, sinking fund reserves, and the accounting for bond and stock issues. [Course VI.]

Cost Accounting—B–26. Preparation: B–25. The major portion of the time scheduled for accounting in the second term of the fourth year of the Textile Engineering course is devoted to a study of this important topic. It is designed to give the student a knowledge of the various cost methods in use at the present time, and involves a thorough discussion of methods of handling and accounting for raw materials, direct labor, and the distribution of overhead expenses. To supplement the instruction, the student is required to work up a cost accounting set. [Course VI.]

Business Law—B–27. Preparation: E–7. Under this subject are given lectures, supplemented by the use of a suitable text, on the law governing contracts, negotiable instruments, sales, bills of lading, real estate and corporation. [Course VI.]

Electives—B–28. Students in the fourth year of the Textile Engineering course will be permitted to elect certain textile subjects as substitutes for part of the time scheduled for engineering subjects. Thus a student is offered an opportunity for specialized study along such lines as will prove most beneficial to him at that time. The selection of elective studies is subject to the approval of the head of the Textile Engineering department and to the possibility of arranging for the same. [Course VI.]

Cotton Yarn Department

CHEMISTRY AND DYEING DEPARTMENT — C.

Elementary Chemistry (Inorganic and Organic Chemistry) — C–1. **Preparation:** Admission Requirements. Instruction in Elementary Chemistry extends through the first year, and includes lectures, recitations and a large amount of individual laboratory work upon the following subjects:—

Chemical Philosophy. — Chemical action, chemical combination, combining weights, atomic weights, chemical equations, acids, bases, salts, Avogadro's law, molecular weights, formula, valence, periodic law, etc.

Non-metallic Elements. — Study of their occurrence, properties, preparations, chemical compounds, etc.

Metallic Elements. — Study of their occurrence, properties, metallurgy, chemical compounds, etc.

The students take up, as thoroughly as time will permit, the qualitative detection of the more common metals and non-metals, with practical work.

The Hydrocarbons and their Derivatives. — Study of their occurrence, properties, preparations and uses. This work, although elementary in character, is of sufficient breadth to prepare the student understandingly for the work with artificial dyestuffs which follows. [All courses.]

Qualitative Analysis — C–2. Preparation: C–1 taken simultaneously. Qualitative Analysis is studied during the second term of the first year. The work consists of lectures, recitations and laboratory work. The student must become familiar with the separations and the detections of the common metals and acids by the analysis of a satisfactory number of solutions, salts, alloys and pigments. At intervals during the term short laboratory tests are given as well as the regular written examinations.

No pains are spared to make the course as valuable to the student as possible, and to encourage only thorough and intelligent work.

When sufficiently advanced, students take up the examination of various products with which the textile chemist must be familiar such as testing mordanted cloths, pigments and the various dyeing reagents.

During the latter part of this course a certain amount of time is devoted to the preliminary operations of quantitative analysis, such as the precipitation and washing of such substances as barium sulphate, magnesium ammonium phosphate and calcium oxalate, although no weighings or actual determinations are made.

A student's marks in this subject depend as much upon the neatness and care used in manipulation as upon the actual results obtained. [Course IV.]

Stoichiometry — C–3. Preparation: B–1, C–1. This subject is taken during the second half of the first year, and is continued throughout the second year as an adjunct to Quantitative Analysis. The application of the metric system is thoroughly studied, and problems are worked involving the expansion and contraction of gases, determination of empirical formulæ, combining volume of gases and quantitative analysis. [Course IV.]

Advanced Inorganic Chemistry — C-4. Preparation: C–1. The whole subject of Inorganic Chemistry is reviewed during the second year, and many advanced topics are introduced which were necessarily omitted from the first-year course in General Chemistry. [Course IV.]

Advanced Organic Chemistry — C-5. Preparation: C–1. In this course, which consists of lectures and recitations, the principles of organic substitution and synthesis are thoroughly discussed, and as many illustrations are used as time will permit, particularly such as are applied in the arts. The aliphatic series of hydrocarbons and their derivatives are studied for about twenty weeks, the remainder of the time being devoted to the benzine series. The aim of the course is to lay a broad foundation for the study of the chemistry of the artificial dyestuffs. Students are required to work out problems in the synthesis of various compounds, in order to become familiarized with equation writing. [Course IV.]

Quantitative Analysis — C-6. Preparation: C–2, C–3. During the second year the principles of analytical work are thoroughly taught, the work being based on Talbot's "Quantitative Chemical Analysis." Gravimetric analysis is studied during the first term, and volumetric analysis during

the second term. The samples analyzed include salts, ores, minerals, bleaching powder and alkalies. Frequent recitations are held for the discussion of methods and the solution of stoichiometrical problems. Students are encouraged to read the standard works and magazines on chemical subjects, in order to cultivate broad views of the science. [Course IV.]

Quantitative Analysis — C-7. Preparation: C–6. This course consists chiefly of technical analysis, the principal consideration being the analysis of water, alum, ammonia, soaps, coal, indigo, tannin and the ultimate analysis of organic compounds, as well as the examination of acids, alkalies, oils, scouring materials and such substances as starches, gums and other thickeners, and the detection of adulterants.

No pains are spared to give the student the benefits of all the latest researches along the lines of industrial analytical methods, and original work is encouraged in all. [Course IV.]

Physical Chemistry — C-8. Preparation: C–4, C–5, B–11. This subject is studied during the third and fourth years. It includes the principles of calorimetry, specific heat, vapor density, the various methods of determining molecular weights, laws of solutions, electrolytic dissociation, theories of precipitation, thermo-chemistry, surface tension, etc. The student is required to work out a large number of problems introduced by the subject. [Course IV.]

Chemistry Technology of Fibers — C-9.

The outline of the lecture course which is given during the second term of the first year is as follows: —

Technology of Vegetable Fibers. — Cotton, linen, jute, hemp, china grass. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Animal Fibers. — Wool, mohair, silk. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Artificial Fibers. — Study of the various forms of artificial silk, the process of manufacture, their properties and action with chemicals, acids and heat. (All courses.)

Dyeing Laboratory — C-10. Preparation: C–13 taken simultaneously. Besides lectures and recitations upon the subject of Textile Chemistry and Dyeing, practical laboratory work is required. By the performance of careful and systematic experiments the student learns the nature of the various dyestuffs and mordants, their coloring properties, their action under various circumstances, and the conditions under which they give the best results. The more representative dyestuffs of each class are applied to cotton, wool and silk, and each student is obliged to enter, in an especially arranged sample book, a specimen of each of his dye trials with full particulars as to the conditions of experiment, percentage of compounds used, time, temperature of dye bath, etc.

For convenience and economy most of the dye trials are made upon small skeins or swatches of the required materials, but from time to time students are required to dye larger quantities in the full-sized dyeing machines which are described elsewhere.

By the use of a small printing machine the principles of calico printing are illustrated, and by means of the full-sized dyeing machines and vats the practical side of the subject is studied. It is the constant endeavor of those in charge to impart imformation of a theoretical and scientific character that will be of value in the operation of a dyehouse. [Course IV.]

Industrial Chemistry (Lecture) — C-12. Preparation: C–4, C–5. During the whole of the third year lectures and recitations are held in industrial chemistry, the course in general following "Thorpe's Outline of Industrial Chemistry." Particular attention is paid to those subjects which are of special interest to the textile chemist, as oils, soaps, gas and coal-tar industry, building materials, and the manufacture on a large scale of important chemical compounds, such as the common acids and alkalies, bleaching powders, various mordants, etc. The course is illustrated as far as possible

with specimens, diagrams and charts, and the students are given an opportunity to visit some of the industrial establishments in the vicinity of Lowell and Boston. [Course IV.]

Textile Chemistry and Dyeing — C–13. Preparation: C–1, B–4, B–7.

Operations Preliminary to Dyeing.—Bleaching of cotton and linen; wool-scouring; bleaching, fulling and felting of wool; carbonizing; silk-scouring and bleaching; action of soap.

The bleaching of cotton cloth, yarn and raw stock is studied at length with detailed description of the various forms of kiers and machinery used; also the action of the chemicals used upon the material, and the various precautions that must be taken in order to insure successful work.

Under this heading is also included an exhaustive study of the reagents used in the emulsive wool-scouring process, and their action upon the fiber under various conditions; also the most successful of the solvent methods for degreasing wool.

Water and its Application in the Textile Industry.—Impurities present, methods for detection, their effect during the different operations of bleaching, scouring, dyeing and printing, and the methods used for their removal or correction.

The important subject of boiler waters is also studied under this heading, with a full discussion of the formation of boiler scale, its disastrous results, and the methods by which it may be prevented.

Mordants and Other Chemical Compounds used in Textile Coloring and Classified as Dyestuffs.—Theory of mordants, their chemical properties and application, aluminum mordants, iron mordants, tin mordants, chromium mordants, organic mordants, tannin materials, soluble oil, fixing agents, leveling agents, assistants, and numerous other compounds, not dyestuffs, that are extensively used in the textile industry.

Under this heading are included the definitions of various terms and classes of compounds used by textile colorists, such as color lakes, pigments, fixing agents, developing agents, mordanting assistants, mordanting principles and leveling agents.

Theory of Dyeing.—A discussion of the chemical, mechanical, solution and absorption theories, and the various views that have been advanced by different investigators of the chemistry and physics of textile coloring processes.

Under this heading are discussed the general methods of classifying dyestuffs and the definitions of such terms as textile coloring, dyeing, textile printing, substantive and adjective dyestuffs, monogenetic and polygenetic dyestuffs.

Natural Organic Coloring Matters.—Properties and application of indigo, logwood, catechu, or cutch, Brazil wood, cochineal, fustic, tumeric, madder, quercitron bark, Persian berries, and other natural dyestuffs that have been used within recent years by textile colorists.

Mineral Coloring Matters.—Under this heading are discussed the properties of such inorganic coloring matters and pigments as chrome yellow, orange and green, Prussian blue, manganese brown, and iron buff.

Artificial Coloring Matters.—General discussion of their history, nature, source, methods of manufacture, methods of classification and their application to all fibers.

Special study of basic coloring matters, phthalic anhydride colors, including the eosins and phloxines; acid dyestuffs, Janus, direct cotton, sulphur and mordant colors, including the alizarines and other artificial coloring matter requiring metallic mordants; mordant acid and insoluble azo colors, developed on the fiber; reduction vat colors, aniline black and other artificial dyestuffs not coming under the above heads.

As each class of dyestuffs is taken up, the details of the methods of applying them upon all the different classes of fabrics and in all the different forms of dyeing machines are thoroughly discussed; also the difficulties which may arise in their application, and the methods adopted for overcoming them.

Machinery used in Dyeing.—A certain amount of time is devoted to the description of the machinery used in various processes of textile coloring, which is supplemented as far as possible by the use of charts, diagrams and lantern slides.

Most of the important types of dyeing machines are installed within the dyehouse of the school, and the students can be taken directly from the lecture room and shown the machines in actual operation. [All courses.]

Advanced Textile Chemistry and Dyeing—C-14. Preparation: C–10, C–13. This is a continuation of the Textile Chemistry and Dyeing Course of the second year, and includes a review of the second year's work in this subject, with the introduction of many advanced considerations, and, in addition, the following subjects:—

Classification and Construction of Artificial Dyestuffs.—A study from a more advanced standpoint of the classification and constitution of artificial dyestuffs including the various methods used in their production, also the orientation of the various groups which are characteristic of these compounds, and their effect on the tinctorial power of dyestuffs.

The object of this study is to give the student a more complete knowledge of the artificial dyestuffs from the color manufacturer's point of view, which will prove of particular value to those who intend later to enter the employ of dyestuff manufacturers or dealers.

Color Matching and Color Combining.—A study of that portion of physics which deals with color and the many color phenomena of interest to the textile colorist. The lecture work is supplemented with the practical application of the spectroscope and tintometer, and much practice in the matching of dyed samples of textile material.

The primary colors both of the scientist and textile colorist, the results of combining coloring lights and pigments, and such subjects as color perception, color contrast, purity of color, luminosity, hue, color blindness, dichroism, fluorescence, and the effect of different kinds upon dyed fabrics, are discussed under this heading.

Each student's eyes are tested for color blindness early in the course, in order that he may be given an opportunity to change his course if his eyes should prove defective enough to interfere with his work as a textile colorist.

A dark room has been provided where various experiments in color work and color matching may be performed.

Dye Testing.—This subject includes the testing of several dyestuffs of each class, subjecting them to the common color-destroying agencies; the determining of their characteristic properties, and their action towards the different fibers; also the determining of the actual money value and coloring power of dyestuffs in terms of a known standard.

Each student is required to make a record of each color tested upon an especially prepared card, which furnishes a permanent record of all dyestuffs, their dyeing properties, fastness to light and weather, washing, soaping, fulling, perspiration, bleaching, steaming, ironing, rubbing, acids and alkalies.

Union Dyeing.—A study of the principles involved in the dyeing of cotton and wool, cotton and silk, and silk and wool union materials in the production of solid and two-color effects.

Textile Printing.—A thorough study of the whole subject of textile printing, each student being required to produce individually no less than twenty different prints, including the following styles: pigment style, direct printing style, steam style with tannin mordant, steam style with metallic mordant, madder or dyed style, the ingrain or developed azo style, discharge dye style, discharge mordanted style, resist style, indigo printing, aniline black printing.

The different parts of the calico printing machine are thoughly studied; also the precautions which must be considered in its use, and the arrangement of the dyeing apparatus which must accompany such a machine.

Special attention is paid to the methods of mixing and preparing the various color printing pastes that are used in the above work upon a manufacturing scale as well as experimentally in the laboratory.

Cotton Finishing.—A study of the various processes of finishing cotton cloth and the different materials used therein. The work involves the discussion of the various objects of cotton finishing and such operations as pasting, damping, calendering, stretching, stiffening, mercerizing, beetling and filling, and the various machines used for carrying out these processes.

Mill Visits.—During the third and fourth years visits are made to some of the large dyehouses, bleacheries and printworks in the vicinity. [Course IV.]

Organic Chemistry Laboratory — C-15. Preparation: C–4, C–5, C–6, C–13. This course, while including practice in the usual methods of organic analysis, and giving excellent training in the principles and manipulations of general organic synthesis, is especially devoted to the synthetic dyestuffs. The student not only prepares many of the representative dyestuffs, but, what is far more important, he carries out all the operations, beginning with coal tar itself. Thus, instead of merely coupling two or more of the foreign imported intermediate products to make a dyestuff, he starts with the basic substances obtained from the coal tar, and makes his own intermediate products. As far as is possible the student will be made acquainted with the problems which might arise in a dyestuff factory, and an excellent opportunity is presented for original work. [Course IV.]

Engineering Chemistry — C-16. Preparation: C–4, C–5, C–6. A series of lectures is given upon the general subject of Engineering Chemistry, which include particularly the consideration of fuels, oils and water from the chemical engineer's standpoint. The elements of chemical engineering are also considered to such an extent as time will permit. [Course IV.]

Industrial Analysis — C-17. Preparation C–6. In conjunction with the lectures in engineering chemistry there is required a specified amount of laboratory work in the Industrial Analysis Laboratory, which has been recently thoroughly equipped with the latest and best apparatus for fuel and oil analysis. [Course IV.]

Microscopy and Photomicrography — C-18. Preparation: B–11, C–4, C–5, C–6, C–13. The value of the microscope in the detection and examination of the various fibers cannot be overestimated, and often facts may be discovered, and conclusions drawn, which could be arrived at in no other way.

The students in this course are given as much work with the microscope as time will permit. They receive instruction in the use of the high-grade microscopes, and not only have practice in the examination and detection of the fibers, but are required to become proficient in the preparation of permanent slides.

Opportunity is also given for students to take photomicrographs of fibers and the various slides which they may prepare. A special dark room has been provided for this purpose. [Course IV.]

Advanced Dyeing Conference — C-19. Preparation: C–13. During the latter part of his course each student will be required to write, for presentation before the other members of his class, a paper upon some assigned subject of general interest. After presentation the subject will be open to discussion and question.

The object of this conference is twofold. First, to give the student experience and practice in systematically looking up an assigned subject, and presenting it before others; and secondly, to bring before the class a greater variety of subjects with more detail than could be covered by the general lectures of the course. [Course IV.]

Advanced Organic Chemistry (Dyestuffs) — C-20. Preparation: C–15. This course consists of an advanced study of the coal-tar coloring matters, their chemistry, relations of their composition to their coloring power, and the chemistry of their preparation. [Course IV.]

Technical German — C-21. Preparation: E–3, C–4, C–5, C–13. This course consists of the reading of German technical literature, with the object of familiarizing the student with the current German publications in textile chemistry and coloring. [Course IV.]

Thesis — C-22. Before graduation the student must present a thesis which shall consist of a report of some original investigation or research that he has conducted while at the school.

A relatively large number of hours are specially set aside for this work, and students are encouraged to select some object for their investigation which shall be of practical as well as theoretical interest. [Course IV.]

TEXTILE DESIGN AND WEAVING DEPARTMENT — D.

Textile Design — D-1. During the first year instruction is given in the subject of classification of fabrics, use of point or design paper, plain fabrics, intersection, twills and their derivation, sateen, basket and rib weaves, checks and stripes, fancy weaves, including figured and colored effects; producing chain and draw from design, and *vice versa;* extending and extracting weaves. [First term, all courses.] [Second term, Courses, I, II, III, VI.]

Decorative Art — D-1. The instruction in this subject commences with the second year for students taking the Design course. During the first term freehand drawing is taught by means of plates, and practice in coloring is given in conjunction with this work.

Practice, in lettering, spacing and general arrangement of designs and sketches is given. The engineering alphabet is used in all work.

During the second term instruction is given in drawing, sketching, coloring and designing, with reference to their application in textiles. Good examples of applied design in textiles, as well as in other branches, are used as a basis for modified designs selected and composed by the student. This stimulates originality as well as teaches the student to appreciate good designs and color. [Course III.]

Cloth Analysis — D-1. In the first year this subject takes up in a systematic manner the analysis of samples illustrating the various cloth constructions for the purpose of determining the design of the weave and the amount and kind of yarns used, and forms the basis of calculation in the cost of reproducing any style of goods. The various topics discussed are reeds and setts; relation and determination of counts of cotton, woolen, worsted, silk, and yarns made from the great variety of vegetable fibers; grading of yarns, folded, ply, novelty and fancy yarns; application of the metric system to yarn calculation; problems involving take-up, average counts, determination of counts of yarn, and weight of yarn required to produce a given fabric. [First year, all courses.]

Textile Design — D-2. For Cotton Goods — Preparation: D–1. During the second year consideration is given to fancy and reverse twills, diaper work, damasks, skip weaves, sateen fabrics with plain ground, backed fabrics, and multiple ply fabrics. Students are required to make original designs and put the same into the loom. Special attention is given to the consideration of color effect.

The analysis of these fabrics forms a part of the course in design. This also includes the necessary calculations required to reproduce the fabric or to construct fabrics of similar character. [Courses I, III, VI.]

Textile Design. — D-3. For Woolen and Worsted Goods — Preparation: D–1. During the second year the instruction given includes warp and filling backed cloth, figured effects produced by extra warp and filling, double cloths, multiple ply fabrics, cotton warps, blankets, bath robes, crêpes, filling reversible, Bedford cords, imitation furs, crépons, matelasse and imitations, double plain, ingrains, velvets, corduroys, overcoatings, trouserings.

The analysis of these fabrics, together with the consideration of the shrinkages and dead loss in all fabrics, theory of diameter of yarns, and costs of mixer blends, is a part of this course. [Courses II, III, VI.]

Textile Design — D-6. Preparation: D–2 or D–3. The advanced work takes up the more complicated weaves adapted to harness work, and leads into leno and Jacquard designs. The following is a brief list of the subject heads, which will give some idea of the course: double plain cloths, ingrains, tricots, chinchilla, tapestry, blankets, upholsteries, spot weaves, pile or

plush, crêpon, matelasse and its imitations, piqué, Marseilles, quilting, and miscellaneous designs for Jacquard, leno, fustian, tissue fabrics and lappets. [Courses I, II, III, VI.]

Cloth Construction — D-7. Preparation: D-2 or D-3. The work includes the application of the different weaves and their combinations in the productions of fancy designs, both modified and original; the calculation involved in the reproduction of standard fabrics changed to meet varying conditions of weight, stock, counts of yarn and value; and the discussion of the breaking strength of fabrics and relationship of the construction of the fabric to breaking strength.

Instruction in this subject, which is given by classroom work, is intended to bring together the principles considered under the subject of design, cloth construction, weaving and yarn making of previous years, and to show the bearing each has in the successful construction of a fabric. [Courses I, II, III, VI.]

Decorative Art — D-8. Preparation: D-4. Original designs and sketches for particular grades of goods and the study of color effects form the important part of the second and third-year courses. It should be understood that work in decorative art is carried on in conjunction with textile construction and weaving, particularly on the Jacquard loom. Designs of merit are carefully developed in detail and woven into cloth. [Course III.]

Decorative Art for Special Students. — This course is planned to give a student a working knowledge and appreciation of design. The first and second years are devoted to a general study of design, color, perspective, lettering and rendering. Drawings are made in the historic styles for all materials, — wood, gold, silver, copper, brass, leather, fabrics, wall papers and glass.

In the third year students should specialize and devote their attention to the material in which they expect to work.

Power Weaving — D-9. Preparation: D-1. In connection with the work in Textile Design and Cloth Analysis practical work is carried on upon the power looms. This includes the preparation of warps, beaming, dressing, sizing, drawing-in and making of chains, the cutting and lacing of cards, spooling and quilling and the machinery for the same. A study is made of warpers and sizing machines, both for cotton and woolen. Lectures are given to correspond with the progress of the student in the Power Weaving Laboratory covering the following subjects: loom adjustments, chain building, shuttle changing looms, dobby looms, single and double acting dobbies, handkerchief motions, leno weaving, center selvedge motions, filling changing looms, oscillating reeds, lappet motions, various shaker motions, towel and other pile cloth weaving, Jacquard looms, single and double lift leno Jacquards, Jacquards of special design, tying up Jacquard harness. [Courses I, II, III, VI.]

Power Weaving — D-10. Preparation: D-9, D-2, or D-3. Instruction is given in weaving on fancy woolen and worsted looms, single and double acting dobbies, leno weaving, various shaker motions, lappet loom weaving, double and single lift Jacquard looms, tying up Jacquard harness, leno Jacquard, harness and box chain building; warp preparation for woolen and worsted and cotton; formulas for making up different kinds of sizing. Lectures are given to correspond with the same. [Courses I, II, III, VI.]

LANGUAGE AND HISTORY DEPARTMENT — E.

English — E-1. Preparation: Admission Requirements. A technically trained man should be able to express himself clearly, forcibly and fluently, as inability to do so will be a serious handicap to him in after life. The object of the English course is to develop the student's power of expression by a thorough study of the principles of advanced rhetoric and composition, and by constant writing of themes illustrative of the four forms of discourse, viz., description, narration, exposition and argumentation. In addition to the study of rhetoric and composition and the writing of themes, several classics such as are not read in the preparatory schools are studied and discussed. [All courses.]

Elementary German — E-2. Preparation: Admission Requirements. This course is intended for first-year students who do not offer German as an entrance requirement and who desire to take the course in chemistry and Textile coloring. It may be selected by students taking the Textile Engineering course who have not fully met the entrance requirements in language. The work is elementary in character, and much time is devoted to the study of the rudiments of German grammar with practice in composition. During the latter part of the year considerable attention is given to the reading of ordinary German prose, which serves as an additional preparation to the student for the later reading of works along scientific and industrial lines.

Advanced German — E-3. Preparation: E–2. For students who are pursuing a degree course the elementary course of the first year is continued throughout the second year. The work consists of the study of some of the more advanced principles of grammar, and especially of the reading of scientific German dealing with a variety of subjects, and the translation of commercial German. [Courses IV, VI.]

Elementary French — E-4. Preparation: Entrance Requirements. This course is intended for first-year students. who elect the Textile Engineering course and who have had two years' work in this subject. Facility in translation is acquired by a considerable amount of reading from general or scientific sources.

Advanced French — E-5. Preparation: E–4. For students who are pursuing the Textile Engineering course and offer two years' preparatory school work in French, a course in translation of scientific French is required during the second year. [Course VI.]

Industrial History — E-6. Preparation: Admission Requirements. The economic history of a nation is not less interesting or dramatic than its political history, while it is absolutely essential to a thorough understanding of modern business conditions. The object of this course, which is intended for second-year students, is to trace the development of the three leading industrial nations of the world, viz., the United States, England and Germany, from simple, isolated agricultural communities to the complex industrial and commercial society of to-day. The course consists of weekly lectures supplemented by textbook reading. Among the topics treated are natural resources; colonization, territorial expansion; manufactures; agriculture; finance; commerce; transportation; revenue tariffs; monopolies; governmental regulation; organization of labor; industrial legislation; immigration; conservation; contemporary problems. During the year each student will be required to write two or more theses on subjects connected with industrial history, in order that he may have practice in research work and also may continue his training in English. [All courses.]

Economics — E-7. Preparation: E–1, E–6. This course consists of lectures supplemented by recitations based upon both the lectures and a textbook. The character of the course is descriptive rather than theoretical, and the aim is to acquaint the student with the accepted principles of economics and some of their applications to industrial conditions.

Among the topics discussed are the nature and scope of economics; the evolution of economic society; the three factors of production land, labor and capital; the four elements in distribution, rent, wages, interest and profits; business organization; value and price; monopoly; money, credit and banking; international trade; protection and free trade; transportation; insurance; economic activities of municipalities; and public finance. In short, the course deals with the fundamental principles that underlie a wide range of activities. [Courses IV, VI.]

COTTON DEPARTMENT — F.

Yarn Manufacturing — F-1. Preparation: B–1, B–4, B–7. Instruction is given by means of lecture and laboratory work. The outline of the course is as follows:—

Fiber. — Before taking up the details of the operation of manipulating the fiber into yarn, a careful study is made of the characteristics and classification,

both botanically and commercially, of the many varieties of the cotton fiber. Methods employed in cultivating, marketing, grading and stapling are considered, and under these heads a detailed study is made of the types of gin employed.

Opening and Picking. — Instruction in the preliminary operation of opening and picking covers the mechanical construction of the machines, their parts and adjustments, as fully as the manufacturing results accomplished by the machines. This includes such construction details as evener, lap measuring and safety stop motion, grids, cleaning trunks, beaters, etc.; also operation details which involve the adjustment of waste, drafts and character of laps.

Carding. — The process of carding is considered one of the most important, and proper time is devoted to the construction and operation of cards that the student may be familiar with the various parts of the card and the function and design of each. The construction and application of card clothing, as well as the methods of grinding, form a part of the work.

Drawing. — Under this head is taken up the theory of doublings and their effect upon the quality of roving and yarn. Like previous and subsequent processes the machine construction forms an important part of the work. Proper stress is paid to such subjects as stop motions, drawing rolls and their covering, cleaners and evener motions.

Roving Processes. — Under this head are studied the various machines known as the slubber, intermediate, fine and jack fly frames. The relative motion of the various parts of these machines is so complex that a good opportunity is here presented to fix in the student's mind the application of certain mechanical principles that are used in other departments and upon other machines in the manufacture of textile material. With each process of yarn manufacture are explained the systems of sizing and numbering, and under this head are taken up both the metric and English systems.

Yarn Manufacturing — F–2. Preparation: F–1. Ring Spinning and Twisting. — The consideration of spinning yarn by the ring frame method involves a knowledge of the uses to which the yarn is to be put, subsequent methods of handling that proper roving may be selected, suitable amounts of draft and twist provided, correct size of rings and travelers selected, building motions suitably adjusted, etc. The operation of twisting yarns is so closely related to spinning by the ring method that it is studied at the same time. This opens an almost limitless field of novelty yarn manufacture, and offers a very good opportunity to derive new types of yarn or new mechanism to produce the effects. Yarn defects are studied with reference to the cause and remedy.

Mule Spinning. — This method of spinning is very different from that of the ring frame, and the mechanical details are more complicated. The student is furnished with new means of producing yarns, and can compare the relative advantage of each method. A thorough understanding of mule spinning is perhaps more a study of mechanical motions and their functions. This results almost invariably in assisting the student to understand previous processes and machines better because of his work on the mule. It is the object to make clear to the student's mind the principles underlying the construction and operation of the parts that control the drawing, twisting, backing off, winding, together with such special motions and devices as are used upon the modern mule.

Combing. — This process is explained by lecture work and by operation and assembling of the various types of combs in service in the laboratory. The object of combing is fully considered, and the different means employed on the many types of combers on the market is studied. This includes such types as the Heilman, New Whitin and Nasmith combers.

Organization. — Following the detailed study of the individual processes it is necessary to consider the relation of each to the other, the programs, balance of production, cost of machinery for various counts, quantities and styles of yarns. Under this heading are also studied such subjects as depreciation of machinery, cost systems, economics, arrangement of machinery, power demands, etc. [Courses I, III, VI.]

Knitting — F-3. Preparation: F–1–2 or G–1. This course, commencing with a study of hosiery yarns and their preparation for knitting, includes a study of the various stitches and their application in commercial fabrics; a study of the different knitting machines, including circular and flat spring and latch needle machines used in the manufacture of stockings, sweaters and underwear; and a study of looping and sewing machines. Part of the work consists of the assembling and adjusting of different types of knitting machines.

In addition, considerable time is spent in the analysis of knitted fabrics. [Courses, I, II, VI.]

WOOL DEPARTMENT — G.

Yarn Manufacturing — G-1. Preparation: B–1, B–4, B–7. Raw Materials. — A study of raw materials which enter into the manufacture of woolen or worsted yarns, or are made into yarns by processes similar to those employed in the manufacture of woolen and worsted yarns, would include silk, mohair, alpaca, vicuna, cashmere, camel's hair, cotton, flax, hemp, jute and ramie. In connection with these are considered shoddy, noils, mungo and extracts.

Wool Sorting. — Familiarity with the various grades and kinds of wool is obtained by lecture and by actual sorting of fleece wool under the direction of an experienced wool sorter. The various characteristics and properties are explained, as are also trade terms, such as picklock, XXX, XX, ½–blood, ⅜–blood, ¼–blood, delaine, braid, etc. Some skill is acquired in the estimation of shrinkage and in judging the spinning qualities.

Wool Scouring. — The object of scouring and the methods employed are explained, and this involves the consideration of the soaps and chemicals used in washing; also the waste products and their utilization. Actual work is done in scouring a commercial quantity of wool by machines that are made similar in operation to regular commercial machines. A study is made of the effect of the hardness of water upon soap; also tests are made to show this effect. At the same time the use of driers, their operation and regulation, is taken up, and the methods of carbonizing wool, noils, burr waste, rags, etc., are studied and practiced.

Burr Picking, Mixing and Oiling. — In these processes, preliminary to carding, the students have an opportunity of mixing various colors of wools to produce different effects, and the influence of varying percentages of a given color in a mixture can be seen. Each student is required to make at least twenty sample mixes combining different colors and grades of stock, and to felt and mount the same. Under the subject of oils and emulsions are taken up the characteristics of various oils and the means employed to test these. The use of mixing and burr pickers is made clear.

Carding. — The different systems of carding wool, depending upon whether it is to be made into woolen or worsted yarn, are fully explained, as is also the construction, setting and operation of the cards. A part of the work is the reclothing and grinding of the cylinders, strippers, workers, etc. The carding of suitable and commercial quantities of wool, and the further manufacture of it into yarn, serves to fix the principles of carding in the mind of the student, as well as to give him some skill in handling machinery. At the completion of this part of the work he is required to prepare and hand in a full description of the process of carding, including working drawings, sketches, etc., to fully explain the machines and the methods.

Woolen Mule. — The student studies thoroughly the operation of the mule as a whole, and acquaints himself with the various principal mechanisms, as, for example, the backing off and winding motions, the quadrant, builder-rail, faller regulation, etc.

Yarn Manufacturing — G-2. Preparation: G-1. Top Making and Combing. — This branch takes up, besides the carding of the wool on a worsted card, the preparing processes; also gilling of the stock before and after combing. The construction of the gill boxes and combs is studied by lectures, and by dismantling and assembling these machines in the laboratories. Later, quantities of stock are made into top and then into yarn.

The Noble and Lister combs are studied, and the various calculations to determine draft, noiling, productions, etc., are made.

Drawing and Spinning. — The equipment in the laboratory offers opportunity to make worsted yarn by either the Bradford or open drawing system or by the French system. The process includes the various machines in the successive steps of making Bradford spun yarn, and the functions of the different machines are studied. In the latter, or French system, the stock is run through the drawing machines, and the roving spun into yarn on the French mule. The same method of studying the mechanisms and operation of these machines is followed as in the case of previous methods of instruction. The student by pursuing this course can compare the different methods of yarn manufacture and note the results of each.

With the instruction on the Bradford system is given work on the twisters and the effects that may be produced.

Organization. — At the end of the course the layout of a properly balanced yarn mill is studied, and at the same time the cost of the machinery, depreciation, labor costs and machinery arrangements. [Courses II, III, VI.]

Textile Testing — G-3. Preparation: F–2 or G–2, D–6, D–7, D–9. The object of this course is to familiarize the student with present-day methods of determining the physical properties of textile fibers, yarns and fabrics. The application of physical laws and methods of measurements, as studied in the Course of Physics, is used in the study of physical characteristics of textile material. The work is given to students in advanced courses, and consists of lecture and laboratory work. Reports are prepared from each experiment, giving the object of the experiment, method of procedure, observation and conclusions, in order that the student may acquire practice and understand the interpretation of data. A special testing laboratory is provided, and a considerable number of the best standard fiber, yarn and fabric testing instruments of foreign and American make have been installed and are used for instruction in the testing of textile materials. The laboratory is equipped with means of making and keeping the humidity constant, so that tests can be made under uniform or standard conditions of humidity and temperature. [All courses.]

FINISHING DEPARTMENT — H.

Woolen and Worsted Finishing — H-1. Preparation: B–4, C–1, D–1, D–9. The outline of this course, which is given by means of lecture and laboratory work, is as follows: —

Burling and Mending. — Under this head is taken up for consideration the examination of flannel as it comes from the loom; the construction, use and location of the perch; the methods used in marking defects, measuring, weighing and numbering of cloths; also the methods of inspection for fancies, single cloths and double cloths. The object of burling, mending and the types of tables employed, the method of removing knots, runners, etc., the object of back shearing and the use of burling irons, the replacing of missing threads and the importance of sewing as a part of the finishing process, are all considered in detail. The removal of oil and tar spots as well as stains of various kinds is studied.

Fulling. — This branch covers a study of the conditions of the flannel as it comes from the loom, and the influence of oil, etc., upon the procedure. Considerable time is devoted to the various methods of producing a felt, the early types of stocks, hammer falling and crank stocks, and their modifications and development into the present type of rotary fulling mills of both the single and double variety. The details of construction in all machines are carefully taken up and include the design and composition of the main rolls, methods of covering, regulation and means of adjusting the pressure of traps and rolls, consideration of the shoes, the use and regulation of the various types of stop motion, the different types of stretchers, guide rolls and throat plates.

The theory of felt is taken up and the influence of pressure, moisture, heat, alkali and acid is considered, as well as the hydroscopic and felting properties

of different wool fibers. The preparation of the flannel for the mill and the usual methods of determining shrinkages, as well as the various methods of soaping, are given careful attention. The preparation of various fulling soaps and the value of each for the production of various degrees of felt, as well as the determination of the proper amount of alkali for various goods, are carefully studied and demonstrated. The manipulation of the various kinds of goods in the mill, viz., all wool, shoddies and mixed goods, is studied in class-room and by operation in the mill.

The change in weight and strength for each operation is carefully considered, as is also the value of the flocks made in each. A study of the various methods of flocking, such as dry and wet, is considered in both class and machine rooms. In each operation the defects likely to materialize are studied, as well as the cause thereof, and various methods of modifying or lessening them.

Washing and Speck Dyeing. — This branch considers the scouring, rinsing and washing of goods both before and after the fulling process; the various types of washers; and the details of construction, such as suds box, rolls, etc. The theory of scouring, uses of Fuller's earth, salt solutions and scours on the different kind of goods are made clear by practical work in the machine room, where the effects due to improper scouring, such as stains, cloudy effects, wrinkles and unclean goods, are demonstrated. The discussion of the necessity of speck dyeing follows naturally from the study of these matters, and includes methods of preparation, materials used, application and tests required.

Carbonizing. — This is an important branch of finishing, and includes a study of the various carbonizing agents, methods of application, strength of solutions, and neutralizing, as well as the machines used. Stains and imperfections resulting from carbonizing are also considered. The drying and tentering machines and extractors employed are taken up at this point.

Gigging, Napping and Steaming. — The construction in detail of the various types of gigs, nappers, steamers, wet gigs, rolling, stretching, crabbing and singeing machines is discussed, and their actions upon the cloth and the results obtained are explained.

Various methods of obtaining luster and the production of permanent finish are considered in connection with steaming and sponging.

Brushing, Shearing and Pressing. — This includes, as do the other branches, a careful treatment of the machine employed, the preparation of the cloth for each process, the action of each machine in producing its part of the resultant effect. In manipulation of the shear consideration is given to its setting, grinding and adjustment. With the brushing machine the effect of steaming and moisture upon the luster and feel of the goods is shown. A study of the action of the presses, both plate and rotary, involves consideration of pressure, steaming, etc. Special processes to obtain particular effects are taken up, and the part played by each machine is explained. The details involved in handling cloth on a commercial scale, as, for example, measuring, weighing, ticketing, numbering and rolling, are also explained. The necessary calculation and the methods of finishing all grades of goods are considered from time to time during the year. [Courses II, III, IV, VI.]

Cotton Finishing — H-2. Preparation: B-4, C-1, D-1, D-9. The outline of the course in the finishing of cotton fabrics is as follows: —

Cloth Room. — Instruction of the various goods and the object thereof; construction of the various types of inspecting and trimming machines.

Shearing.—The object. A consideration of the various types of shears for treating one or both sides at the same time; also the use of the usual cleaning devices, such as emery, sand and card rolls, beaters and brushes; grinding and the adjustment of the various parts.

The use of brushing and cleaning machines, rolling devices and calender attachments for gray goods.

Singeing. — Developing and object of singeing; the construction of singers of all types, and for various purposes; the use of cooling tanks, steaming devices, rolling and brushing attachments.

Regulation of the flame for various goods, and adjustment of the parts; gas and air pressure, water-cooled rolls; the effect of moisture on the cost of singeing; the use of dry cans in connection with singeing; electric singeing.

Washing. — Open width and string washers, their construction and operation; soaps, temperature, squeeze rolls; washing of various goods and the object thereof; stains.

Napping. — The object of napping and the ususal method of treating goods; various types of nappers, single and double acting; felting nappers; construction, grinding and adjustments of various types.

Water Mangles. — Their objects and the construction of various types; various rolls, iron, husk, etc.; scutchers, their object and constructions.

Starch Mangles. — The object and construction of all types of starch mangles for pure starch and filled goods; various types of rolls, brass, rubber, wood; action of doctor blades, etc.; regulation and object of pressure.

Methods of starching and finishing all standard goods, also a consideration of the various substances used, such as starch, softener and fillers; the preparation of starch and various methods of application.

Dryers and Stretchers. — Both horizontal and vertical, tenter frames, clips; the swing motion and the finishes thus produced; construction; spraying machines, belt stretchers, button breakers; their object and construction.

Calenders. — The object and construction of all types, including the regulation of pressure and nips for the production of various finishes; various types of rolls and their uses, — steel, husk and paper; the use of hot and cold rolls; chasing, friction, embossing and Schriner calenders, and the various finishes produced by each; production of watered effects; beetling machines.

Making up room, — yarding, inspecting; different types of folds; pressing, papering, marking. [Courses I, III, VI.]

PHYSICAL EDUCATION — I.

All members of the freshman class are required to take a course in physical training conducted in the gymnasium under the direction of an instructor in physical education. Two periods per week for the entire first year are devoted to this work. At the beginning of the year a full record is made of the physical examinations carried on by the instructor and a reputable physician that proper and beneficial exercise may be prescribed.

The object is to give general instruction in the care and strengthening of the body, and to so guide the students that they may continue to give proper thought to their physical training that their mental development may have its greatest effect.

Proper gymnasium clothing is required and all students must take a shower bath following each exercise.

BUILDINGS AND GROUNDS.

The site is a commanding one, consisting of about 15 acres at a high elevation on the west bank of the Merrimack River. It extends to and overlooks the rapids of Pawtucket Falls, which was the first water power in America to be used on an extensive scale to operate power looms. It was contributed by Frederick Fanning Ayer, Esq., of New York City, and the Proprietors of the Locks and Canals on the Merrimack River.

Southwick Hall, the main building, fronting on Moody Street, was contributed by the Commonwealth of Massachusetts and Frederick Fanning Ayer, Esq., and is a memorial to Royal Southwick, a leading textile manufacturer, a public man of earlier days, and a maternal ancestor of Mr. Ayer. It includes a central mass 90 by 90 feet, having three stories and two wings 80 by 85 feet each with two stories and well-lighted basements. The building is pierced in the center by an arched way from which access is had to the wings and to the central courtyard. The northern wing is occupied by the General Offices, Engineering and Finishing departments, and Library, while the southern wing is entirely occupied by the Chemistry and Dyeing departments.

Kitson Hall, dedicated to the memory of Richard Kitson, was contributed by Charlotte P. Kitson and Emma K. Scott, his daughters; the Kitson Machine Company of Lowell, founded by Mr. Kitson, was also a generous contributor. This hall makes a right angle with Southwick Hall, is 70 by 183 feet, and has two stories and a basement. The first floor is occupied by the Cotton Yarn and Knitting departments, while the basement contains the Mechanical and Electrical Engineering laboratories and the Machine Shop.

The Falmouth Street Building forms the third side of the quadrangle, and consists of three portions, one 60 by 75 feet, three stories, one 75 by 130 feet, three stories, and the head house 70 by 80 feet, three stories and basement. The building is occupied by the picker section of the Cotton Yarn Department, the Design and Power Weaving Department and by the Woolen and Worsted Yarn Department, and contains on the lower floors an equipment for the manufacture of wool yarn from the fleece to the finished yarn. The upper floors are occupied by a great variety of plain, dobby and Jacquard looms, and in a section of the building are the students' lockers and recreation rooms.

Colonial Avenue Building was erected in the summer of 1910 from plans prepared by the Engineering Department, which also had in charge the work of construction. The building completes the fourth side of the quadrangle, and in outward appearance corresponds to the architectural features of the other school buildings. It is a single-story building, and has the dimensions of 195 by 60 feet. Its interior is faced with cement brick made at the school during the progress of the work. These serve to give light reflecting walls which are advantageous for the work of the Wool Manufacturing, Cotton Finishing and Chemistry and Dyeing departments that occupy this building. The funds for this building were provided by the State of Massachusetts.

The buildings are all built of light brick with granite and Indiana limestone trimmings. They are of modern mill construction adapted to educational uses. The floor space of the several departments is as follows:—

	Square Feet
Cotton Yarns and Knitting,	16,200
Woolen and Worsted Yarns,	28,160
Textile Design and Decorative Art,	16,806
General Chemistry and Dyeing Laboratories,	28,400
Finishing Cotton, Woolen and Worsted,	10,606
Power Weaving,	15,360
Textile Engineering,	24,297
Power plant,	10,047
Assembly and physical culture halls,	10,800
Entrances, corridors, stairways, etc.,	14,487

Additional floor space is devoted to Administration, Offices, Library, classrooms, storerooms, etc.

CAMPUS.

Through the generosity of Mr. Frederick Fanning Ayer the school has been provided with a campus and athletic field of about 3 acres. This has been carefully graded and laid out for baseball, football and track athletics.

To enclose this field the Alumni Class Fence has been partly built. It is made of forged iron sections supported between brick columns. Each section is contributed by a class, so that in the course of a few years this fence will entirely enclose the field.

On the upper floor of the Falmouth Street Building there has been provided a recreation room for the use of the students at such times as their attendance is not required in classes.

In the basement of this building there are rooms for the use of the athletic teams. Connected to these are showers and dressing rooms.

The upper hall of Southwick Hall has been equipped with gymnastic apparatus. Chest weights, wooden dumb-bells, Indian clubs, a set of traveling

rings, a vaulting horse, parallel bars, a punching bag and several sets of foils and single sticks have been provided.

In order to be sure that no student having any dangerous physical weakness takes part in any athletic contest, all candidates for the various athletic teams are obliged to pass a satisfactory physical examination.

EQUIPMENT

The equipment of machinery, inventoried at $330,850.00, is most varied for textile educational purposes, and is being constantly augmented. The builders of the various machines installed keep in close touch with the school, adding to the machines such improvements as are made from time to time, and each year some new machine will be added by a manufacturer who finds it to his advantage to be represented here. This operates to the mutual advantage of student and manufacturer.

Cotton Yarns Department. — The opening and picking section of this department contains a 40-inch two beater breaker lapper with automatic feeder, a 40-inch single beater intermediate and finisher lapper with Perham & Davis sectional plate evener, apron to double four laps, a 40-inch single beater finisher lapper with Perham & Davis sectional plate evener, apron to double four laps, and a Kirschner patent carding beater, a roving waste opener and a thread extractor, all of which have been installed by the Kitson plant of the Saco-Lowell Shops at Lowell.

There is also a 50-saw gin from the Daniel Pratt Gin Company of Prattville, Alabama, besides facilities for teaching the grading and classification of cotton.

The carding, combing and drawing section contains the following machinery from the Saco-Lowell Shops: —a top flat card, three revolving flat cards, two of which form a unit for waste carding, three railway heads and two drawing frames. One of these cards is equipped by the Chapman Electric Neutralizer Co., Portland, Maine, with an electric neutralizer to prevent troubles from static electricity.

The Whitin Machine Works, Whitinsville, Mass., have installed a 40-inch revolving flat card, a sliver lapper, one four-head and a six-head ribbon lapper besides a two-head, a six-head and an eight-head comber.

The H. & B. American Machine Works of Pawtucket, R. I., are represented by the following pieces of machinery: — one 40-inch revolving flat card, one two-delivery drawing frame, a roving frame, spinning frame and ring twister.

The Foster Machine Company of Westfield, Mass., has provided two winders for making cones and multiple wound tubes.

There is also a two-head comber with a model comber head made by John Hetherington & Sons, Ltd., Manchester, England.

The roving, spinning, and twisting section has the following machinery installed by the Saco-Lowell Shops of Lowell: — two slubbers one of which is for waste spinning, an intermediate, a fine and a Jack frame, also five ring spinning frames, a spinning mule, spooler and a wet and dry twister.

The Fales & Jenks, Pawtucket, R. I., and the Draper Corporation of Hopedale, Mass., have each provided a wet and dry twister; the Whitin Machine Works, three spinning frames, the Woonsocket Machine and Press Company, Woonsocket, R. I., an intermediate fly frame, and the Asa Lees Company, Oldham, England, through their agents, Wm. Firth Company, a fine spinning mule.

Knitting Section. — The winders for this section include a six-spindle Universal winder for cones and tubes and a Payne bobbin winder.

The machines in the following group are equipped with special attachments for producing lace front work, high splicing, double soling and striped work. The hosiery machines include two Acme full automatic, one arranged for 160 needles and the other for 200 needles; also a Mayo Model C full automatic arranged for 220 needles. Scott and Williams have placed in this section three of their machines, two arranged for 220 needles and one arranged for 200 needles — Model B–5. There are three Banner

machines, all full automatic, two of which are arranged for 220 needles each and one arranged for 200 needles. There is one Brinton full automatic arranged for 176 needles and one Branson hand machine arranged for 80 needles. For hosiery legs and tops there are 5 ribbers, made by the Wildman Company, with cylinders varying from $3\frac{1}{2}''$–$5\frac{1}{4}''$ and arranged for needles varying in number from 160–240; 2 Brinton ribbers, one arranged for 176 needles and the other 200 needles; 1 Brinton tie machine, $1\frac{3}{4}$-inch cylinder, 100 needles and 49 needles.

The underwear machinery consists of one Crane spring needle machine, one Scott & Williams ribber, and one Wildman ribber.

Under the group of flat machines there are three Lamb machines, one arranged for knitting gloves and one arranged for knitting sweaters. In addition to these there is also a Grosser sweater machine, a Jacquard machine, and a link and link machine; a Dubied scarf machine; and a Raschel warp knitter.

For finishing work this section includes a Grosser 2-thread looper, one Hepworth looper, two Beattie loopers; 5 Union special sewing machines for overseaming, double stitch covering, seaming and welting and vest finishing; 6 Merrow sewing machines, including two shell stitch machines and three over-seaming and crocheting machines; 3 Singer machines.

For instruction in the manufacture of braids the New England Butt Company has installed one 24-line Hercules braider, one 12-line braider, one tubular braider, and one soutache braider. To illustrate the preparation of silk warps the Atwood Machine Company, Stonington, Conn., has furnished a winder, a ribbon quiller, a warper and beamer, Swiss style, also a double frame to be used with these machines.

Wool Yarns Department. — For instruction in wool sorting and grading the room is provided and equipped with benches, baskets, etc., as well as standard samples of all grades of wool which may be used for comparison and examination.

The scouring and carbonizing equipment installed by C. G. Sargent's Sons Corporation consists of one cone duster for grease wool; four scouring bowls arranged in tandem with necessary feeds and modern carrying properties; one single apron dryer, with automatic feeder; one carbonizing screw acid tank and duster, with crush rolls. In this same department the North Chelmsford Machine Company have supplied a rinse box; Schaum & Unlinger, one hydro-extractor; C. S. Dodge, one shoddy picker and one bagging stand.

Woolen. — In the woolen section there has been installed by the Atlas Manufacturing Company a Parkhurst Burr picker. The Davis and Furber Machine Company have installed a mixing picker equipped with improved mixing picker feed and Spencer oiler, both made by George S. Harwood & Son, Boston, Mass. There are three sets of woolen cards furnished by Davis and Furber Machine Company which are equipped with Bramwell feed furnished by George S. Harwood & Son. One of the sets has the first and second breaker cards coupled. All have apron condensers on the finishers. There is a sample mixing card furnished by the Torrance Manufacturing Company which offers an opportunity for carrying on experiments and mixing various kinds and colors of wool. There are two spinning mules, 120 spindles each, one furnished by the Davis & Furber Machine Company of North Andover and equipped with bobbin holders supplied by the American Bobbin Holder Company, West Medway, Mass., and the other furnished by Johnson & Bassett, Worcester, Mass. In addition to these two mules each company has supplied for the purpose of instruction a spinning mule head mounted on movable platform to facilitate class instruction. Besides these mules the Davis & Furber Machine Company have supplied a fancy yarn twister, 20 spindles; the Lindsay Hyde Company a modern skein winder. For Card grinding the B. S. Roy and Son Company of Worcester, Mass., have supplied one grinding frame and two traverse grinders; T. C. Entwistle Co., Lowell, Mass., one traverse grinder; W. H. Brown, Worcester, Mass., one complete set of carder's tools.

Experimental Dyeing Laboratory

Worsted. — In the worsted section the Davis & Furber Machine Company have furnished one double-cylinder worsted card (4 licker-in) with Bramwell feed. On this card as well as one in the woolen section the Chapman Electric Neutralizer Company have supplied one of their patented electric neutralizers. This section also includes a double bowl, 5-cylinder back-washer, with gill box, Taylor-Wadworth & Co., Leeds, Eng., equipped with blueing motion, oiling motion, and Layland patent pressure motion; a weigh gill box and creel and one doubling balling head gill box (with double screws) made by the Saco-Lowell Shops of Lowell, Mass.; a worsted comb with baller punch made by Crompton & Knowles, Worcester, Mass.; two finishing gill boxes, one known as a can gill box and the other a balling head gill box, both made by Hall & Stell, Keighley, Eng.

For the manufacture of yarns under the Bradford System of Drawing, Spinning and Twisting the following machinery as made by Prince Smith & Son, Keighley, Eng., make up the equipment: one revolving creel for 12 balls, one 2-spindle drawing box, one 4-spindle first finisher, one 12-spindle dandy reducer, one 12-spindle cap spinner, one double head can gill box, one 2-spindle gill box, one 2-spindle flyer spinner, one 12-spindle ring spinner, one 12-spindle 2-fold cap twister, one 12-spindle 6-fold ring twister. In addition to this the Saco-Lowell Shops, Lowell, Mass., have installed the following machinery to carry on similar work: one 2-spindle drawing box, one 6-spindle second finisher, one 24-spindle dandy rover, one 6-spindle cone reducer, one 8-spindle cone rover, one 48-spindle cap spinner, 5-foot end, one 48-spindle cap spinner, 4-foot end, one 48-spindle Boyd ring twister. For conditioning yarn C. G. Sargent's Sons Corporation have supplied one of their conditioning machines. The Universal Winding Company have installed one of their 6-gang winders, equipped for cones or straight tubes.

The humidity in the laboratory of the woolen yarns and of the English system of worsted yarns is maintained by the American Moistening Company's system through their automatic control. In this laboratory are installed six humidifiers and four Comins' High Duty heads, which are supplied from an electric driven triplex power pump located in the power house. This same pumping equipment supplies the American Moistening Company's humidifiers operating in the Cotton Yarn Department.

For the manufacture of worsted yarns under the French System of Drawing and Spinning the machinery has been made by the Societe Alsacienne de Constructions Mechaniques, Mulhouse, France, and the equipment consists of the following: Model P. L. B. comb with creel for 24 doublings, intersecting gill box (2 heads), gill box (2 heads), first drawing (2 heads), second drawing (2 heads), third drawing (2 heads), reducer (4 porcupines), slubber (8 porcupines), first intermediate (8 porcupines), second intermediate (8 porcupines), rover (8 porcupines), finisher (16 porcupines), self-acting worsted mule (150 spindles).

The Saco-Lowell shops have recently built and installed a ring spinning frame of 60 spindles for worsted yarns equipped with individual General Electric Company's motor and a Reeves Variable Speed Transmission.

Twelve turbo humidifier heads automatically controlled by a humidity regulator have been furnished by the G. M. Parks Company, Fitchburg, Mass. The compressed air for these heads is supplied by an Ingersoll-Rand 8 by 8 steam-driven air compressor.

For the purpose of determining the physical properties of fibers, yarns, and fabrics there has been installed a Textile Testing Laboratory where there are the necessary microscopes and micrometers, a skein testing machine, an electric conditioning oven made by the Emerson Apparatus Company of Boston; single yarn and fabric strength testing machines made by G. R. Smith & Co., Bradford, England; a strength testing machine, capacity 500 kilograms, for testing twines and fabrics; a fiber testing machine for testing fibers and fine yarns with capacity, 1 gram to 1.5 kilograms; a yarn strength testing machine with capacity, 1,000 to 5,000 grams; and a yarn strength testing machine with capacity, 5 to 30 kilograms, all of which have been made by Louis Schopper, Leipzig, Germany. Besides these we have

a standard yarn and fabric testing machine as made by Henry L. Scott & Company of Providence, R. I., and a Mullen Tester. For the automatic control of temperature and humidity there has been installed by the American Moistening Company of Boston one of their automatic humidity and temperature regulators.

Design and Power Weaving Department. — In the fabric analysis section there has been provided chemical balances made by Voland & Sons and Christian Becker, necessary twist testers, microscopes, reels, etc., as well as a Torsion calculation balance made by the Torsion Balance Company of New York.

In the warp preparation department there has been installed by the Saco-Lowell Shops one of their spoolers besides a warper and a slasher for preparing cotton warps; a beamer by T. C. Entwistle Company of Lowell, a 400-end improved Draper warper furnished by the Draper Corporation of Hopedale, Mass. The Whitin Machine Company, Whitinsville, Mass., have supplied a 180-spindle, long-chain quiller and the Johnson & Bassett Company, Worcester, Mass., a quiller of their make. The Universal Winder Company has supplied a winder for copy and bobbin winding and an 8-spindle doubler.

The woolen and worsted warp preparation department contains two 40-end Jack spoolers, two spool racks for 12 spools each, one pattern dry frame dresser, one pipe and cylinder dresser, one 60-inch reel, one 82-inch reel, and one double head beamer, all supplied by the Davis & Furber Machine Company of North Andover, Mass.

The Weaving Department contains four looms supplied by the Draper Corporation of Hopedale, Mass., which include a plain Northrup, an 8-harness corduroy, an improved Northrup, a Northrup with dobby. The Stafford Loom Company of Readville, Mass., has installed one plain, one cam, one dobby loom and one broad sheeting loom all equipped with individual motors; the Whitin Machine Works, Whitinsville, Mass., a side cam twill, a plain print cloth loom, equipped with Kip-Armstrong electric warp stop motion; the Kilburn and Lincoln a plain loom; Lewiston Machine Company a 4-harness side cam and a bag loom; Crompton and Knowles Loom Works a jean loom and a plain loom with individual drive. Four of these looms are equipped with Abbott cleavers made by the Abbott Wire and Cast Steel Warp Cleaving Company, Lisbon Falls, Me. The Hopedale Manufacturing Company of Milford, Mass., has recently installed one of its high speed plain looms with individual motor.

The fancy loom section includes a Stafford Ideal 16-harness automatic shuttle-changing loom, a Whitin 20-harness dobby loom and the following furnished by the Crompton-Knowles Loom Works: — Knowles gingham 4 by 1 boxes, Crompton gingham 4 by 1 boxes, one Crompton towel 2 by 1 boxes, two Terry towel and one huck towel looms, a 16-harness lappet loom, a 20-harness dobby 4 by 1 boxes, fancy leno loom, and a Crompton fancy cotton single cylinder 20-harness dobby.

The woolen and worsted section contains a Knowles 20-harness Gem, a Crompton 24-harness worsted 4 by 4 boxes, a Crompton 6 by 1 double cylinder 20-harness dobby, one heavy 20-harness 4 by 4 boxes, one 20-harness and one 25-harness blanket, seven intermediate woolen 25-harness 4 by 4 boxes and two 90-inch 25-harness heavy woolen looms.

The Jacquard loom section includes one Stafford silk loom, 1,200-hook, Halton head; one 400-hook, single-lift, Schaum & Uhlinger Jacquard, mounted for 4-bank, narrow fabric loom; one Felix Tonnar German plush loom, with 400-hook Crompton & Knowles Jacquard head; one Skinner Brussels carpet loom, three-quarters wide, equipped with 1,280-hook Jacquard head presented by the Bigelow-Hartford Carpet Company, Clinton, Mass. The Crompton & Knowles Loom Works have furnished one Knowles fancy loom, single-lift Jacquard; one Knowles fancy loom, double-lift Jacquard; one Knowles fancy loom, Jacquard tied up for leno, one Knowles ingrain carpet loom, 4 by 4 boxes, one Knowles loom, 4 by 4 boxes, 54-inch, with 600-hook double-lift double-cylinder McMurdo Jacquard head,

tied up for damask napkin designs, one Crompton ingrain carpet loom, 4 by 4 boxes, one Crompton & Knowles 72-inch tapestry loom, with 2,600-hook Halton Jacquard head, one 840-hook double-lift, single-cylinder Jacquard on Crompton & Knowles 4-bank ribbon loom, one 800-hook, double-lift Knowles Gem silk brocade Jacquard machine, 4 by 4 boxes.

For the purpose of card cutting there has been furnished one Jacquard fine index card-cutting machine by John Royle & Sons, Paterson, N. J.; one Jacquard French index card-cutting machine by the same concern and one Jacquard French index card-cutting machine, presented by the Bigelow-Hartford Carpet Company, Lowell, Mass.

Chemistry and Dyeing Department. — The Chemistry laboratories consist of one to give instruction in General Chemistry and Qualitative Analysis and provides facilities to take 120 students. The Quantitative Laboratory takes care of some 50 students and contains the necessary drying closet, steam bath, electrolytic table, with ample facilities to provide distilled water through the use of a Barnstead Water Still. The Balance Room which is adjacent to the laboratory has eleven analytical balances made by such concerns as Christian Becker, Eimer & Amend, and H. L. Becker's Sons & Co. The Organic Laboratory has facilities to take care of approximately 25 students having the necessary equipment required in the preparation of basic organic compounds and instruments used in the manufacture of dyes such as autoclaves, electric and gas combustion furnaces.

For the purpose of carrying on photographic and microscopic experiments and analyses the laboratory has been provided with equipment which includes besides the Bausch & Lomb microscopes, a polariscope made by Franz Schmidt & Haensch, Berlin, Germany, a Gaestner spectroscope, a Bausch & Lomb Model G photomicrographic apparatus equipped with D. D. S. microscope and all necessary apparatus, a Kodak projection printer. In the dark room there has been placed a piece of apparatus for determining the relative fading powers of various light sources. Besides the common gas and electric lamps there is installed a solar determinator, made by the Atlas Electric Company, Chicago, Ill., also a 400-watt Nela Trutint and color matching unit made by Nela Specialties Division, Cleveland, Ohio.

The Chemical Museum has been provided with cases and representative dyestuffs all furnished by various dyestuff manufacturers of this country and abroad. This offers an unparalleled opportunity for students to study and experiment with almost all of the representative dyes which are used in the textile industry.

The Experimental Dyeing Laboratory is equipped with individual benches, small dyeing apparatus, reels, balances, apparatus for dye testing, such as frames for exposing dyed material to light, and a complete collection of dyestuff samples and sample cards. There are also fifty-six steam coil experimental dyeing baths, a drying chamber and aging chamber, in addition to a Hurricane Dryer, Class D, made by the Philadelphia Drying Machinery Company, Pennsylvania. Adjacent to the Experimental Dyeing Laboratory there has been provided a well-lighted room for the storage of a great variety of dyestuffs. Steel shelving has been arranged so that the samples are easy of access. All samples are catalogued in a card file, thus facilitating their use. In this same room are provided a sink and cement table with balances.

The Experimental Printing Laboratory is equipped with a calico printing machine, made by Mather & Platt, Manchester, Eng., an iron jacketed steaming chamber from A. Edmeston & Son, Patricroft, Eng., and a set of steam jacketed copper kettles.

The Fuel and Oil Analysis Laboratory contains the following equipment for the analysis of coals and fuels: a Mather bomb calorimeter, with complete outfit, an Emerson bomb calorimeter, with complete outfit, a Parr calorimeter, an Abbe refractometer, a Torsion viscosimeter, a Tagliabue viscosimeter, a Tagliabue cold test apparatus, a Pensky Martin oil tester, a New York State oil tester, a Sartorius specific gravity balance, two Becker analytical balances, gas muffle furnace, Kny-Scherer oil tester, a Graefe gas

calorimeter, an Orsat gas analysis apparatus, laboratory tables, lockers, and hoods.

The Industrial Chemistry Laboratory contains the following: one filter press, Type E. T. Shriver & Co., a single-acting triplex plunger pump, Goulds Manufacturing Company, a vacuum drying apparatus, a surface condenser, a Packard vacuum pump, Norman Hubbard's Sons, a vacuum evaporator, Swenson system, American Foundry and Machine Company, a centrifugal, C. H. Chavant & Co., a double jar mill, F. I. Stokes & Co.

For the purpose of carrying on dyeing on a basis which is more comparable with commercial practice there is provided a laboratory which includes the following equipment: a small kier, fitted with E. D. Jefferson's circulating device, an electrolyzer for manufacturing bleaching solutions, the National Laundry Machine Company, Dayton, Ohio, a Permutit filter, the Permutit Company, New York City, a mercerizing machine, a raw stock dyeing machine, Klauder-Weldon Dyeing Machine Company, Yardley, Pa., a yarn dyeing machine, Klauder-Weldon Dyeing Machine Company, a jig dyeing machine, the Textile-Finishing Machine Company, Providence, R. I., a set of drying cans by the same concern, a chain dyeing machine, T. C. Entwistle Company, Lowell, Mass., a raw stock drying table, Proctor & Schwartz, Philadelphia, Pa., a padding mangle, Arlington Machine Works, Arlington, Mass., a hydro-extractor, W. H. Tolhurst & Son, Troy, N. Y., a Psarski experimental dyeing machine, a Hussong experimental dyeing machine, equipped for raw stock or yarns, a Rodney Hunt sample piece dyeing machine, equipped with an automatic temperature and pressure-regulating apparatus, made by C. J. Tagliabue Manufacturing Company, Brooklyn, N. Y. The Franklin Process Company, Providence, R. I., have furnished a 25-pound bronze dyeing machine. Of the various dye tubs, one is equipped with a Monel Metal lining to withstand the action of various chemicals and dyes.

Finishing Department. — The Woolen and Worsted section includes a 2-string washer, a fulling mill, furnished by the Rodney Hunt Company, Orange, Mass.; a sample fulling mill, a kicker mill, furnished by James Hunter & Co., North Adams, Mass.; an up and down dry gig, a rolling and stretching machine, an up and down wet gig, a steam finishing machine, a 60-inch, 3-burner singeing machine, adapted for cotton, silk or worsted goods, a 2-cylinder double-acting brushing machine, a 60-inch, 4-cylinder sanding and polishing machine, furnished by Curtis & Marble, Worcester, Mass.; a 6/4 double shear, an A. W. C. measuring and weighing machine, furnished by Parks & Woolson, Springfield, Vt.; a dewing machine, a 6/4 Voelker rotary press, furnished by G. W. Voelker & Co., Woonsocket, R. I.; a single shear, Curtis & Marble, donated by Massachusetts Mohair Plush Company, Lowell, Mass.; a tentering and drying machine furnished by John Heathcote, Providence, R. I.; a single crabbing machine, H. W. Butterworth & Son, Philadelphia, Pa.; a 72-inch woolen napper, Davis & Furber, North Andover, Mass.; a 32-inch basket hydro-extractor, W. H. Tolhurst, Troy, N. Y.; a Lintz & Eckhardt cloth numbering machine, improved by Durbrow & Hearne Manufacturing Company, New York; a steam press for underwear, United States Hoffman Company, Syracuse, N. Y.; a sewing machine, Birch Brothers, Somerville, Mass.

The Cotton section includes a 40-inch inspecting and brushing machine, a 44-inch No. 25 railway sewing and rolling machine, a 44-inch cotton shearing machine, Type No. 34, a 44-inch No. 3 steam calender rolling machine, a 40-inch cloth folder, a 40-inch winder and measurer, a set 44-inch shear blades for grinding purposes, furnished by Curtis & Marble, Worcester, Mass.; a 48-inch No. 4 opening, sewing and re-rolling machine, a No. 1 hand power portable railway sewing machine, furnished by Dinsmore Manufacturing Company, Salem, Mass.; a 40-inch, 3-roll water mangle, with husk and brass rolls and usual attachments and equipped with a 48-inch Mycock scutcher, and a 40-inch Mycock cloth expander made by Thomas Leyland & Co., Boston, a 40-inch, 2-roll starch mangle, a 40-inch upright drying machine with 10 copper cylinders equipped with Files dry

can system, Files Engineering Company, Inc., Bridgeport, Conn., a 40-inch sprinkler, a 40-inch, 5-roll Universal calender with chasing attachment and equipped with a 40-inch Mycock cloth expander, and a pasting table with plate, furnished by the Textile-Finishing Machinery Company, Providence, R. I.; a 16 by 24 inch bronze-covered stretcher for the drying cans, C. A. Luther & Co., Providence, R. I.; a 40-inch double bristle stretcher for drying cans, American Finishing Machinery Company, Boston, Mass.; a 40-inch Tommy Dodd starch mangle, H. W. Butterworth & Sons Company, Philadelphia, Pa. and a 44-inch, 50 foot vibratory tentering machine. This machine is directly driven by a 7½-horsepower variable speed motor and is equipped with a Schwartz automatic electric guider, made by L. H. A. Schwartz & Co., Boston, Mass.

Engineering Department. — The Steam Engineering Laboratory contains the following equipment arranged for experimental purposes: A 50-horsepower Allis-Chalmers Corliss steam engine direct connected to an Alden absorption dynamometer, and piped to exhaust its steam to the atmosphere, to a Wheeler surface condenser or to the Kerr turbine; a Kerr seven-stage turbine driving directly a 25-kilowatt Richmond Electric Company's alternating current generator and piped to exhaust either to the atmosphere or the condenser. It may be operated either as high pressure or low pressure turbine, and the generator has special connections to illustrate various commercial phases. In addition there are a 4 by 6 Deane triplex power pump, two 2-inch centrifugal pumps made by the Lawrence Machine Company, Lawrence, Mass., a Clayton air compressor and necessary tanks, scales and measuring instruments. For the measurement of flow of air there are a steam driven Sturtevant fan and a motor-driven Massachusetts fan with heater combined for heating and drying experiments.

For instruction in leveling and surveying there are provided three engineer's transits, leveling rods, etc.

The Electrical Engineering Laboratory consists of two sections, one of which is devoted to instruction in the generation and transmission of power, and contains the necessary switchboard and instruments to control a 25-kilowatt alternating current turbo generator and a 15-kilowatt motor-generator set arranged to supply either direct or alternating current. In addition there are a 24-horsepower direct current Allis Chalmers motor and a 10-horsepower direct current General Electric motor also a 10 and a 7.5 horsepower General Electric alternating current motors besides a General Electric 3-kilowatt rotary transformer and three Westinghouse stationary transformers. The other section of the laboratory is known as the instrument laboratory and is for the purpose of giving instruction in the measurement of current voltage, resistance and in the calibration of instruments. It contains a 5-kilowatt Crocker-Wheeler balancer, a 160-ampere hour storage battery, a 5-kilowatt 220-volt to 440-volt General Electric transformer, a Westinghouse portable wattmeter with current and potential transformers, three wattmeters, two ammeters and a voltmeter all of the General Electric portable alternating current type, a 30-volt alternating current Roller Smith voltmeter, a 5 to 10-scale Weston ammeter (electro dynamometer type), a Weston millivoltmeter with 2, 20, 50 and 200 ampere shunts, three 250-volt direct current Weston voltmeters, a 150-ampere, two model 45, two model 260 Weston portable ammeters, a Weston model 260 voltmeter, a Thompson 50-ampere recording wattmeter, a General Electric rotating standard wattmeter, two General Electric induction type watt hour meters, an Esterline portable curve drawing wattmeter, a 100-ampere Leeds & Northrup Standard Resistance, a Leeds & Northrup Ayrton shunt, a Weston laboratory standard voltmeter with 600-volt multiplier, a Leeds & Northrup potentiometer, a D'Arsonval wall type galvanometer, a Wheatstone bridge with galvanometer, a slide wire bridge, an electro-dynamometer, Weston Standard cell, potential phase shifter, a standard Leeds & Northrup photometer with Lummer-Brodhun screen, and Macbeth illuminometer made by the same concern.

Machine Shop. — The equipment of the machine shop is as follows: Four standard engine lathes, 13-inch swing, 6-foot bed, from Flather & Co., Nashua, N. H.; three standard engine lathes, 14-inch swing, 6-foot bed, from Flather & Co., Nashua, N. H.; a standard engine lathe, 15-inch swing, 6-foot bed, from F. E. Reed Company, Worcester, Mass.; an engine lathe, 18-inch swing, 10-foot bed, from Flather & Co., Nashua, N. H.; an engine lathe, 18-inch swing, 6-foot bed, from Champion Tool Works, Cincinnati, Ohio; a standard engine lathe, 15-inch swing, 6-foot bed, from S. H. Putnam Sons, Fitchburg, Mass.; five speed lathes, 17-inch swing, 5-foot bed, from J. G. Blount, Everett, Mass.; one No. I Universal milling machine, with all three feeds automatic, from Kempsmith Manufacturing Company, Milwaukee, Wis.; one 24 by 24 inch, 6-foot planer, from the Mark Flather Planer Company, Nashua, N. H.; one 23-inch upright drill, with back gears and power feed, from J. E. Snyder & Son, Worcester, Mass.; one 14-inch single sensitive drill, from the Stanley Manufacturing Company, Lawrence, Mass.; one No. 1 Universal grinder, from Landis Tool Company, Waynesboro, Pa.; one 20-inch wet tool grinder, from J. G. Blount, Everett, Mass.; one 12-inch, 2-wheel dry grinder, from J. G. Blount, Everett, Mass.; an American twist drill grinder, from the Heald Machine Company, Worcester, Mass.; one Type 1B portable electric grinder from the Cincinnati Electric Tool Company, Cincinnati, Ohio; one 30-inch grindstone and frame, from the Athol Machine Company, Athol, Mass.; a single spindle centering machine, from D. E. Whiton Machine Company, New London, Conn.; one 15-inch shaper, from Potter & Johnson, Pawtucket, R. I.; one power hacksaw, from the Fairbanks Company, Boston, Mass.; one cold saw, from John T. Burr & Son, Brooklyn, N. Y.; one Eureka metal power saw, Manning, Maxwell & Moore; one Type CC electric drill, Cincinnati Electric Tool Company; one Universal milling attachment for Kempsmith milling machine, Taylor Machinery Company; one Hisey Type B ½-horsepower tool post grinder, Taylor Machinery Company; one No. 2 Cory bench straightener, Manning, Maxwell & Moore; one No. 3 Universal cutter and reamer grinding machine, Browne and Sharpe; a well-equipped tool room containing a selected stock of the best makes of small tools, such as drills, taps and dies, milling cutters, reamers, gauges, micrometers, etc.

Power. Light, Heat and Ventilating Plant. — In the new power house, completed in 1913, there is located the main power-generating apparatus for supplying light, heat and power to all departments of the school. The equipment here consists of: two 250-horsepower Heine water tube boilers, equipped with Perfection grates, a 300-horsepower Aultman & Taylor horizontal water tube boiler, equipped with United States rocking grates, two boiler feed pumps — one a Knowles and the other a Deane — a 40,000-pound Cochrane metering open-feed water heater, which is provided with a Lea recorder, and a Cochrane oil extractor heats and measures all feed water, a 3-inch Venturi meter in feed line with indicating manometer as made by the Builders Iron Foundry, Providence, R. I. In the Engine Room are located: a Payne 14 by 14 automatic high speed engine, 125-horse power direct connected to 75-kilowatt, 220-volt, direct-current Bullock generator, a 9½ by 11 Nash gas engine of 50-horsepower, 4-cycle type, with speed-regulating clutch and a "hit and miss" governor, direct connected to a 30-kilowatt, 220-volt, direct-current Bullock generator, a 65-kilowatt motor generator set, consisting of a direct current motor and an alternating current generator. This unit may be run either A. C. to D. C. or D. C. to A. C., and was made by the Westinghouse Electric and Manufacturing Company. A steam-driven Ingersoll-Rand 8 by 8 air compressor, for use with Turbo heads, installed in the French Spinning Department by the G. M. Parks Company, Fitchburg, Mass., a 5½ to 6 motor-driven air compressor, with 20 cubic foot storage tank for use in starting Nash gas engine, a Cross oil filter. The station switchboard is of marine-finished slate, 90 inches in height, and consists of three generator panels and two circuit panels.

The power house is connected with the main school buildings by a tunnel through which all wires, steam and water pipes are carried. The steam

pipes supply heat to the buildings by means of direct radiation, and by means of the Sturtevant double duct heating and ventilating system located in the basement of Southwick Hall, and by the Sturtevant fan and heater located in the basement of Kitson Hall. Direct-driven exhaust fans are placed on the roof of Southwick Hall and in the basement laboratories.

ALUMNI ASSOCIATION.

The Alumni Association of the School holds its annual meeting and banquet in May of each year in Lowell, Mass.

The membership of the association is restricted to graduates of the day school. Honorary membership is open to the Board of Trustees, the faculty and such others as may be elected by the association.

The officers for the years 1924–25 are: —

President, William Walker, Jr., '04.
Vice-President, Harold W. Cheney '06.
Secretary-Treasurer, Arthur A. Stewart, '00.

Board of Directors: the President, Vice-President, Secretary-Treasurer, George A. Boyd, '05, for two years.

Communications should be addressed to Arthur A. Stewart, Lowell Textile School.

Entertainment Committee.

Arthur J. Hennigan, '06, *Chairman;* Royal P. White, '04; Everett B. Rich, '11; James F. Dewey, '04; Harold W. Cheney, '06.

GRADUATES, JUNE 5, 1924.

Graduates with Titles of Theses.

Bachelor of Textile Engineering.

Howard Mason Brigham, Upper Montclair, N. J. "An Investigation to Determine the Effect of the Picking and Carding Operations upon the Strength of Yarn." (With William H. Villa.)

Leland Hildreth Chapman, Pepperell, Mass. "A study of the Power Consumption in a Cotton Spinning Frame." (Presented in 1923.)

Anant Vithal Datar, Inchalkaranji, India. "An Investigation to Establish a Practical Commercial Standard for the Strength and Stretch of Warp Yarns used in the Manufacture of Standard Print Cloths." (With Edward T. Dunnican.)

Edward Tunis Dunnican, Passaic, N. J. Thesis with Anant V. Datar.

Ray Baldwin Farwell, Groton, Mass. "Power Factor and Efficiency, and their Relation to Textile Mill Operation." (Presented in 1923.)

Martin Alexander Feldstein, Lakewood, N. J. "Design of a Device to Measure Tension in a Spinning Yarn."

Edwin Daniels Fowle, Malden, Mass. "The Possibility and Advisability of Damp Spinning Cotton."

Frederick Kilby Hall, Milton, Mass. "A Comparative Study of the Tape Condenser versus the Apron Condenser on Woolen Cards."

George Kenneth Lewis, Nashua, N. H. "A Comparative Study of the Effect of Different Drawing Processes upon the Strength, Elasticity and Evenness of a Cotton Yarn."

Philip Russell Lowe, Andover, Mass. "The Effect of Regain upon the Strength and Elasticity of Worsted Fabric."

John Joseph McCann, Jr., Lowell, Mass. "A Study of Worsted Cap and Ring Twisting." (Presented in 1923.)

Joshua Miller, Dorchester, Mass. "An Investigation of the Possibility of Using Increased Spinning Drafts on Cotton Ring Spinning Machinery." (With Stephane F. Toupin.)

Stephane Frederic Toupin, Lowell, Mass. Thesis with Joshua Miller.

William Horace Villa, New York, N. Y. Thesis with Howard M. Brigham

Leonard Edward Wilcox, Lowell, Mass. "An Investigation to Show the Relation Between Yarn Strength and Fiber Strength in a Three Ply-Five Ply 23^s Cotton Tire Yarn."

Bachelor of Textile Chemistry.

Arthur Illman Anderson, Wakefield, Mass. "A Study of Dihydroxydiphenyl with Special Reference to the Synthesis of Azo Dyes." (With Raymond Babigan.)

Raymond Babigan, Lowell, Mass. Thesis with Arthur I. Anderson.

Charles Edward Bachelder, Lowell, Mass. "Classification of American Manufactured Dyes according to Schultz Farbstofftabellen." (With George P. Feindel and Berkeley L. Hathorne.)

Lester Harold Bailey, Lowell, Mass. "A Study of the Application and Properties of the American Vat Colors."

Edward Benjamin Bell, Lowell, Mass. "The Dyeing Properties of Artificial Silk." (With James M. Booth.)

James M. Booth, Boonton, N. J. Thesis with Edward B. Bell.

Wen Pei Chen, Shanghai, China. "A Study of the Chemistry of Cotton Finishing" also "A Comparative Study of the Dyeing of Silk with Special Investigation to the Application of Vat Colors."

David Scott Clement, Providence, R. I. "The Study of Wool Oils, their Application and Effect on the Dyeing Process."

Joseph Richard Donovan, Dorchester, Mass. "An Investigation and Study of the Processes of Applying Basic Colors to Textile Materials so that the Colored Material will be fast to Crocking."

William Ernest Durgin, Lowell, Mass. "Carbonization of Vegetable Matter in Woolen Cloth."

George Paul Feindel, North Wilmington, Mass. Thesis with Charles E. Bachelder and Berkeley L. Hathorne.

Berkeley Lewis Hathorne, Stoneham, Mass. Thesis with Charles E. Bachelder and George P. Feindel.

Philip Stanley Johnson, Lynn, Mass. "The Preparation and Investigation of Alpha-Amino-Anthraquinone Derivatives."

Everett Vernon Steele, Marblehead, Mass. "Hydrosulfites and their Application to Textile Processes."

Diplomas Awarded.

Cotton Manufacturing.

Harry Wyatt Duguid, Fitchburg, Mass. "Studies in the Manufacture of a Cotton Shirting."

James Albert Horne, Malden, Mass. "Studies in the Manufacture of a Cotton Shirting."

Wool Manufacturing.

Frederic Christian Beck, Southbridge, Mass. "The Manufacture of a Worsted Suiting."

Paul Edward Carr, Cambridge, Mass. "The Manufacture of a Worsted Suiting."

Charles Alvah Mitchell, Somerville, Mass. "Reproduction of a Worsted Suiting."

Carl Oscar Olson, West Somerville, Mass. "The Manufacture of a Worsted Suiting."

Raymond Reynolds, Lowell, Mass. "The Manufacture of a Worsted Suiting."

William Anthony Rivers, Montpelier, Vt. "The Reproduction of a Worsted Suiting."

Millard Kenneth Thomas Ryan, Natick, Mass. "The Manufacture of a Woolen Suiting."

Frank Kenfield Smith, Montpelier, Vt. "The Manufacture of a Woolen Suiting."

George Hamilton Sweeney, Cambridge, Mass. "The Manufacture of a Worsted Suiting."

Textile Design.

George Jerrard Bienstock, New York, N. Y.
Samuel Joseph Burger, Brooklyn, N. Y.

Prizes awarded in June, 1924.

The Medal of the National Association of Cotton Manufacturers awarded to the student taking course in Cotton who maintains the highest average in scholarship throughout this course. To *Philip Russell Lowe.*

The Edward A. Bigelow Prizes.—$100 to the member of the graduating class pursuing the Wool Manufacturing course who shall have attained the highest average in scholarship during his three years. To *Frederic Christian Beck.* $50 to the member of the second year class in the Wool Manufacturing course who maintains the highest average in scholarship during his second year. To *William Albert Robinson.* $25 to the member of the first year class in the Wool Manufacturing course who maintains the highest average in scholarship during his first year. To *Joseph Adrien Lussier.*

Saco-Lowell Prize of $100 to the student or students presenting the best Engineering thesis preparatory to graduation. To *Philip Russell Lowe.* Honorable Mention, *George Kenneth Lewis.*

Textile Colorist Award of $100 to the student or students in the graduating class whose thesis based upon personal researches and experiences indicates the greatest practical value to the dyeing, bleaching, finishing or textile printing industries. To *Arthur Illman Anderson* and *Raymond Babigan.*

The Louis A. Olney Book Prizes offered to students taking the regular Chemistry and Textile Coloring Course.

$20 to the student presenting the best thesis preparatory to graduation. To *Lester Harold Bailey.*

$10 to the student who shall be considered as having attained the highest scholarship in first year chemistry. To *Stephen Kenneth Ford.*

$5 to the student who shall be considered as having attained the second highest scholarship in first year chemistry. To *Clarence Hooper.* Honorable Mention, *George William Musgrave.*

$10 to the student who shall be considered as having attained the highest scholarship in second year chemistry. To *William Charles Smith.*

$5 to the student who shall be considered as having attained the second highest scholarship in second year chemistry. To *Fred William Sturtevant.* Honorable Mention, *Samuel Mazer.*

REGISTER OF DAY STUDENTS.

Seniors.

Candidates for Degree.

Name, Home Address and Course	*Lowell Address*
Anderson, Clarence Alfred, Norwood, Mass., VI	Y. M. C. A.
Baker, Maurice Sidney, Dorchester, Mass., IV	———
Cohen, Raphael Edvab, Lowell, Mass., IV	63 Ware Street
Crowe, Joseph Bailey, Lowell, Mass., IV	220 Thorndike Street
DelPlaine, Parker Haywood, Lowell, Mass., IV	14 Mt. Washington Street
Ellis, Dorothy Myrta, Lowell, Mass., VI	61 Ellis Avenue
Fisher, Russell Todd, Boston, Mass., VI	———
Hibbard, Frederick William, Lawrence, Mass., IV	———
Hindle, Milton, Lowell, Mass., VI	Phi Psi House
Hollstein, William Diedrick, Lowell, Mass., VI	822 Merrimack Street
Morrison, Haven Asa, Lowell, Mass., IV	51 Sixth Street
Pierce, George Whitwell, Somerville, Mass, IV	———
Runnells, Harold Nelson, Concord, N. H., IV	28 Dumerle Street
Sandlund, Carl Seth, Nashua, N. H., VI	———
Sargent, Robert Edward, Haverhill, Mass., IV	———
Scanlon, Andrew Augustine, Lawrence, Mass., IV	———
Villa, Luis Jorge, Medellin, Colombia, S. A., IV	100 Riverside Street

Name, Home Address and Course	*Lowell Address*
Weinstein, Edward Joseph, Hadlyme, Conn., VI	47 Mt. Vernon Street
Wu, Clarence Wen-Lon, Hankow, China, VI	337 Riverside Street
Wu, Tsung-Chieh, Shanghai, China, VI	135 White Street

Diploma Students.

Anderson, Harold Robert, Lowell, Mass., II	22 Rose Avenue
Antulonis, William Vincent, Stoughton, Mass., III	Delta Kappa Phi House
Bradford, Harold Palmer, Malden, Mass., II	———
Burmon, Albert Nathaniel, Brookline, Mass., II	Delta Kappa Phi House
Carter, Russell Albert, Andover, Mass., II	———
Dowd, Francis Joseph, Boston, Mass., II	———
Fletcher, Howard Varnum, Lowell, Mass., III	398 Princeton Street
Gwinnell, George Harry, Pittsfield, Mass., II	Delta Kappa Phi House
Isaacson, George Franklin, Waltham, Mass., II	———
Linsey, Edward, Malden, Mass., II	———
McKinstry, James Bradley, Southbridge, Mass., II	Delta Kappa Phi House
Martin, Walter Wellington, West Somerville, Mass., II	Omicron Pi House
Moore, Edward Francis, Lowell, Mass., II	Delta Kappa Phi House
Robinson, William Albert, Lowell, Mass., II	14 Mt. Washington Street
Shenker, Nahman, Lowell, Mass., III	42 Riverside Street
Somers, Benjamin, Boston, Mass., II	———
Sutcliffe, Henry Mundill, Lowell, Mass., II	93 Avon Street
Swain, Harry LeRoy, Kent, Ohio, I	Delta Kappa Phi House
Teague, Charles Baird, Somerville, Mass., II	———
Villeneuve, Maurice Arthur, Dorchester, Mass., II	Delta Kappa Phi House
Wilman, Rodney Bernhardt, Brookline, Mass., II	Phi Psi House
Yacubian, Levon Mardrois, Somerville, Mass., II	———
Ziock, Roy, Lowell, Mass., II	Delta Kappa Phi House

Juniors

Baker, Franz Evron, Winchendon, Mass., VI	28 Mt. Vernon Street
Bouteiller, Earle Kenneth, Lowell, Mass., VI	Phi Psi House
Brosnan, William, Francis, Lowell, Mass., IV	38 Second Avenue
Buchan, Norman Spaulding, Andover, Mass., IV	———
Chase, Robert Wentworth, Canton, Mass., IV	Omicron Pi House
Cote, Theodore Charles, Groveland, Mass., IV	———
Coupe, George Edward, Jr., Lowell, Mass., VI	16 West Bowers Street
Feustel, Kurt Erich, Passaic, N. J., VI	Phi Psi House
Godfrey, Harold Thomas, North Andover, Mass., VI	———
Joy, Thomas, Lowell, Mass., VI	28 Mt. Vernon Street
Kennedy, Francis Charles, Holyoke, Mass., VI	Delta Kappa Phi House
Kuo, Limao, Taichowfu, China, VI	302 Salem Street
McKay, Benedict Josephus, Stoughton, Mass., IV	28 Mt. Grove Street
Mason, Philip Edwin, Malden, Mass., IV	Omicron Pi House
Mazer, Samuel, Roxbury, Mass., IV	———
Meeker, Samuel, Lowell, Mass., IV	295 Foster Street
Merrill, John Leslie, Lowell, Mass., VI	96 Dingwell Street
Parkin, Robert Wilson, Maynard, Mass., VI	Hurd Street
Schreiter, Ehrich Ernest Max, Walpole, Mass., VI	Y. M. C. A.
Smith, Ambrose Trowbridge, Lowell, Mass., IV	37 Varney Street
Smith, William Charles, Chadwicks, N. Y., IV	Omicron Pi House
Sturtevant, Fred William, Lowell, Mass., IV	60 Grove Street

Sophomores.

Baker, William Samuel, Lowell, Mass., I	93 Avon Street
Battles, Samuel Cook, North Andover, Mass., II	———
Bentley, Byron, Methuen, Mass., II	———

Name, Home Address and Course	*Lowell Address*
Bradford, William Herbert, Jr., Lowell, Mass., III	Phi Psi House
Bullard, Edward Allen, Wrentham, Mass, VI	137 Riverside Street
Burke, Francis Harold, Franklin, Mass., III	28 Mt. Grove Street
Callahan, John Joseph, Jr., Somerville, Mass., II	———
Connorton, John Joseph, Jr., Concord Junction, Mass., III	37 Varney Street
Cranska, Floyd, Manchaug, Mass., I	51 Sixth Avenue
Darby, Avard Nelson, Billerica, Mass., II	———
Davis, Robert Lincoln, Waltham, Mass, III	———
Dolan, William Francis, Lowell, Mass., IV	56 Crowley Street
Estabrook, William Warren, Lowell, Mass., III	236 Salem Street
Farley, Clifford Albert, Lowell, Mass., VI	215 Princeton Street
Flood, Thomas Henry, Lowell, Mass., IV	49 Madison Street
Flynn, Thomas Joseph, Pittsfield, Mass., IV	Delta Kappa Phi House
Ford, Stephen Kenneth, Bradford, Mass., IV	———
Franks, Jerome, Brooklyn, N. Y., VI	106 Crawford Street
Frederickson, Charles Joseph, Jr., Shawsheen Village, Mass., IV	Delta Kappa Phi House
Gallagher, Raymond Thomas, Lowell, Mass., II	117 Methuen Street
Gilman, Ernest Dana, Methuen, Mass., II	———
Gladwin, Albert Bangs, North Weymouth, Mass., II	Omicron Pi House
Glickman, Bernhardt, Mattapan, Mass., IV	———
Goldenberg, Louis, Dorchester, Mass., VI	17 Edson Street
Goodwin, Whitman Garton, West Somerville, Mass., II	———
Greenwood, John Roger, Jr., Millbury, Mass., II	123 Riverside Street
Guild, Lawrence Winfield, Wollaston, Mass., VI	Phi Psi House
Hathaway, William Tabor, North Cambridge, Mass., II	———
Hooper, Clarence, Shirley, Mass., IV	———
Hyde, Alvin Manning, East Brimfield, Mass., II	Omicron Pi House
Kenney, Frederick Leo, Franklin, Mass., II	37 Varney Street
Kingsbury, Stanley Charles, Malden, Mass., II	———
Lawlor, John Warren, West Somerville, Mass., VI	———
Leavitt, George Herbert, Old Town, Me., II	37 Varney Street
Leonard, Leo Edward, Worcester, Mass., VI	Phi Psi House
Lundgren,Paul Henry, Waltham, Mass., II	Omicron Pi House
Lussier, Joseph Adrien, Woonsocket, R. I., II	793 Merrimack Street
MacKenzie, Ronald Smith, Concord Junction, Mass., II	Omicron Pi House
McGuire, Edward Perkins, Brookline, Mass., VI	Phi Psi House
McKinnon, Norman, Lowell, Mass., VI	179 Princeton Street
Meyers, Chester William, Billerica, Mass., IV	———
Musgrave, George William, Webster, Mass., IV	52 Mt. Washington Street
Parigian, Harold Hrant, Hudson, Mass., IV	91 Mt. Washington Street
Parsons, Charles Sumner, East Milton, Mass., VI	793 Merrimack Street
Patenaude, Harold John, Ashuelot, N. H., II	821 Merrimack Street
Peterson, Halvar Alfred, Waltham, Mass., II	———
Redding, Leslie Capron, Woonsocket, R. I., II	793 Merrimack Street
Reinhold, Kurt Herman, Clifton, N. J., VI	Phi Psi House
Robinson, Marjorie Lorettor, West Somerville, Mass., IV	193 Avon Street
Rossi, Lawrence Louis, West Roxbury, Mass., II	———
Rubin, Juan Diaz, Puebla, Mexico, VI	90 Mt. Vernon Street
Ryan, David Louis, Natick, Mass., II	Phi Psi House
Sawyer, Richard Morey, Winchester, Mass., VI	———
Schneiderman, Jacob, Dorchester, Mass., III	———
Shea, John Francis, Fitchburg, Mass., IV	52 Mt. Washington Street
Sheindelman, Ephraim Frank, New York, N.Y., IV	135 Foster Street

Name, Home Address and Course	*Lowell Address*
Simpson, Robert, Lowell, Mass., I	201 Nesmith Street
Simpson, William Martin, Jr., Malden, Mass., II	Phi Psi House
Skinner, Everett William, Lowell, Mass., VI	Delta Kappa Phi House
Slack, John Taylor, 2nd, Springfield, Vt., VI	137 Riverside Street
Slamin, Alfred Francis, Wellesley, Mass., I	37 Varney Street
Smith, Allen Batterman, Winchester, Mass., I	198 Pawtucket Street
Stass, John George, Lisbon Falls, Me., II	250 West Sixth Street
Sullivan, Richard O'Brien, Groton, Mass., II	———
Tanguay, Gerard, Woonsocket, R. I., IV	Phi Psi House
Tarpey, Thomas Joseph, Somerville, Mass., IV	———
Vangor, John, Bridgeport, Conn., IV	Phi Psi House
Vincent, William Henry, Hyde Park, Mass., III	25 Putnam Avenue
Wingate, Edward Lawrence, Jr., Malden, Mass., VI	———
Wood, Richard Farmer, Concord, Mass., III	Omicron Pi House
Woodbury, Kenneth Leroy, Bradford, Mass., VI	———
Wright, William Eaton, Waltham, Mass., II	———
Wyatt, Andrew Harper, Fitchburg, Mass., III	———

Freshmen

Adams, Durward Webster, Claremont, N. H., VI	43 Plymouth Street
Adams, Ernest Albion, Boston, Mass., II	52 Mt. Washington Street
Anderson, Harry Eric, Lowell, Mass., VI	39 Daniels Street
Barry, Leo Joseph, Cambridge, Mass., VI	———
Bassett, Walden Elbridge, Andover, Mass., I	———
Bastow, Frank Wilson, Jr., Pittsfield, Mass., II	100 Riverside Street
Birdsall, Edgar Wallace, Southbridge, Mass., IV	236 Salem Street
Bronson, Howard Seymour, Portage, Wis., VI	142 Riverside Street
Burns, Robert, Easthampton, Mass., IV	142 Riverside Street
Burrage, Butler Dana, Lowell, Mass., II.	65 Harvard Street
Burtt, Richard Flint, Lowell, Mass., II	385 Walker Street
Carle, Earle Richards, Melrose Highlands, Mass., III	Phi Psi House
Cartier, Edward George, Biddeford, Me., IV	141 Pawtucket Street
Connor, Thomas Francis, Roxbury, Mass., II	503 Beacon Street
Corbett, James Francis, Dracut, Mass., IV	———
Dods, James Barber, Alton, Ont., VI	51 Sixth Avenue
Eberstaller, Alfred Christian, Bethel, Conn., II	142 Riverside Street
Fasig, Paul Leon, Reading, Pa., IV.	118 Mt. Washington Street
Feinberg, Benjamin, Newton, Mass., II	123 Riverside Street
Ferris, Arthur Leon, Port Rowan, Ont.,VI	90 Mt. Vernon Street
Fitzgerald, John Francis, Lawrence, Mass., IV	———
Forgeot, George Cutler, Jr., Boston, Mass., IV	43 Plymouth Street
Franks, Raymond George, Brooklyn, N. Y., IV	106 Crawford Street
French, Philip Roland, Jr., Andover, Mass., II	———
Frost, Edgar LeRoy, Reading, Mass., VI	———
Gallagher, John Waters, Danbury, Conn., II	142 Riverside Street
Goddard, Langdon Warren, Concord Jct., Mass., II	236 Salem Street
Goodman, Sylvester Wynn, New York, N. Y. II	52 Mt. Washington Street
Goodwin, John Carroll, Franklin, Mass., IV	137 Riverside Street
Gottschalck, Lawrence, Gloversville, N. Y., VI	121 Mt.Washington Street
Hanscom, Edwin Thomas, Sanford, Me., II	142 Riverside Street
Harper, John Edward, Squantum, Mass., III	52 Mt. Washington Street
Henderson, Harry Earle, Lowell, Mass., VI	392 Westford Street
Hetherman, Patrick Joseph, Lowell, Mass., IV	306 School Street
Hill, Ernest Wolfenden, Attleboro, Mass., III	137 Riverside Street
Hitchon, Howard Frank Manley, Norwich, Conn., III	137 Riverside Street
Holbrook, Ralph Wentworth, Watertown, Mass., IV	———

Name, Home Address and Course	*Lowell Address*
Holland, Hubert Thomas, Jr., Jamaica Plain, Mass., II	———
Howarth, Andrew John, Oxford, Mass., II	Delta Kappa Phi House
Keach, Elliott William, Danielson, Conn., I	137 Riverside Street
Killheffer, John Vincent, North Caldwell, N. J. IV	93 Mt. Vernon Street
Killheffer, Theodore Fegley, North Caldwell, N. J., VI	93 Mt. Vernon Street
Kilton, Lyman Hayward, Jr., Worcester, Mass., II	Y. M. C. A.
Konieczny, Henry, Dracut, Mass., IV	———
Lindsly, Walter Coburn, Lowell, Mass., IV	49 Nesmith Street
Livingston, Philip Talbot, Wilmington, Mass., IV	———
Logan, George Leslie, South Portland, Me., VI	142 Riverside Street
Lord, George Frederic, Lawrence, Mass., II	———
McKittrick, Raymond Wellington, Lowell, Mass., VI	15 Hawthorne Street
Morrill, Luther Choate, Lowell, Mass., VI	571 Westford Street
Noyes, Harold Albert, Dover-Foxcroft, Me., VI	338 Fairmount Street
Osborne, George Gordon, Washington, Conn., VI	63 Varnum Avenue
Perry, Manfred Clement, Amherst, Mass., I	201 Nesmith Street
Pratt, Wallace Heywood, Jr., Braintree, Mass., II	25 Seventh Street
Rodalvicz, Francis Rudolph, Anthony, R. I., IV	793 Merrimack Street
Russell, William Samuel, Jr., Haverhill, Mass, VI	———
Sampson, Clifford William, Plymouth, Mass., IV	529 Moody Street
Savage, Lawrence Alexander, Camden, S. C., I	142 Riverside Street
Shedd, Jackson Ambrose, North Chelmsford, Mass., III	———
Simmons, Osborne Arthur, Lowell, Mass., VI	3 Branch Avenue
Smith, Roger Dennis, Haverhill, Mass., II	159 White Street
Somers, Samuel Jack, Brookline, Mass., II	———
Steward, Paul Lowden, Skowhegan, Me., III	445 Stevens Street
Storey, Alvin Briggs, Belding, Mich., VI	Y. M. C. A.
Strout, Kenneth Edward, South Portland, Me., VI	142 Riverside Street
Swanson, John Harold, Crompton, R. I. IV	793 Merrimack Street
Tarshis, Elias Aaron, Springfield, Mass., IV	Y. M. C. A.
Waite, Byron Osmond, Livermore Falls, Me., I	Y. M. C. A.
Walter, Ian Campbell, West Somerville, Mass., II	———
Ward, George Chester, Andover, Mass., IV	———
Warren, Eva Maybelle, Billerica, Mass., IV	———
Watts, Stirling, Glen Ridge, N. J., I	63 Varnum Avenue
Way, John Maglathlea, Concord, Mass., IV	147 Gershom Avenue
Westaway, John Chester, Hamilton, Ont., VI	90 Mt. Vernon Street
White, Leon Weston, Stoneham, Mass., IV	———
Whittemore, Fred Lincoln, Jr., West Medford, Mass., VI	———
Wiech, Raymond Edward, Lowell, Mass., IV	84 First Street
Willey, Everett Merle, New Beford, Mass., II	315 Pawtucket Street

Special Students.

Aldaba, Vicente Carasig, Los Banos, P. I., I	———
Bachmann, Alfred Richard, Lowell, Mass., III	146 Parkview Avenue
Beck, Frederic Christian, Southbridge, Mass., IV	Delta Kappa Phi House
Chapman, Clarence Lyman, Moosup, Conn., III	———
Derrickson, Howard Pool, Lowell, Mass., III	825 Merrimack Street
Finley, William Elmer, Pleasantville, N. Y., I	299 Dutton Street
*Forsythe, Nina Beckwith, Berkeley, Cal., III	———
Greer, Bertrand Calvert, North Adams, Mass., I	Y. M. C. A.
Lariviere, George Joseph, Danielson, Conn., I	125 Mt. Washington Street

* Deceased.

Name, Home Address and Course	*Lowell Address*
McArthur, John Maurice, Lowell, Mass., VI	32 New York Street
Morrill, John Anderson, Cambridge, Mass., III	Y. M. C. A.
Ray, Edna, Manistee, Mich., III	193 Avon Street
Rice, Walter Franklin, Manchester, N. H., VI	———
Shibley, Fred Joseph, Fairfield, Me., III	47 Mt. Vernon Street
Stevens, Brooks, Dracut, Mass., III	———
Turner, Carl Frederick, Lowell, Mass., II	92 Stevens Street
Wiesner, Alfred Maxwell, Manchester, N. H., III	43 Plymouth Street

ALPHABETICAL LIST OF GRADUATES

The following list has been corrected in accordance with information received previous to February 1, 1925. Any information regarding incorrect or missing addresses is earnestly solicited.

B.T.C. indicates the degree of Bachelor of Textile Chemistry; B.T.D. indicates the degree of Bachelor of Textile Dyeing; B.T.E. indicates the degree of Bachelor of Textile Engineering; D indicates a diploma; C indicates a certificate (covering a partial course only). Degrees were issued beginning with the year 1913.

Abbot, Edward Moseley, II, '04 (D). Vice-President and Agent, Abbot Worsted Company, Graniteville, Mass.

Abbott, George Richard, II, '08 (D). Andover, Mass.

Adams, Floyd Willington, VI, '16 (B.T.E.). Superintendent, The Barrett Company, Peoria, Ill.

Adams, Henry Shaw, I, '05 (D). Secretary and Treasurer, The Springstein Mills, and Eureka Cotton Mills, Chester, S. C.

Adams, Tracy Addison, IV, '11 (D). Division Superintendent, Arnold Print Works, North Adams, Mass.

Albrecht, Charles Henry, IV, '17 (B.T.C.). Chemist, Wood Worsted Mills, Lawrence, Mass.

Almquist, George John Edwin, I., '19 (D). Assistant General Manager, Passaic-Bergen Lumber Company, Passaic, N. J.

Anderson, Arthur Illman, IV, '24 (B.T.C.). Chemist, with R. G. Knowland, Chemical Engineer, 88 Broad Street, Boston, Mass.

Anderson, Arthur Julius, IV, '19 (B.T.C.). Chemist, Thermo Mills, Inc., West Sand Lake, N. Y.

Annan, David, II, '23 (D). With Quinapoxet Manufacturing Company, Quinapoxet, Mass.

Arienti, Peter Joseph, IV, '10 (D). Chief Chemist, Sayles Finishing Plants, Inc., Saylesville, R. I.

Arundale, Henry Barnes, II, '07 (D). Chief Inspector of Yarns and Fabrics, Sidney Blumenthal Company, Shelton, Conn.

Atwood, Henry Jones, II, '23 (D). Designer and Assistant to Superintendent, Sutton's Mills, North Andover, Mass.

Avery, Charles Henry, II '06 (D). Died January, 1913.

Babigan, Raymond, IV, '24 (B.T.C.). Examiner, United States Patent Office, Washington, D. C.

Bachelder, Charles Edward, IV, '24 (B.T.C.). Dye Chemist, American Cellulose and Chemical Manufacturing Company, Ltd., Amcelle, Md.

Bailey, Joseph W., I, '99 (D). Agent, Butler Mill, New Bedford, Mass.

Bailey, Lester Harold, IV, '24 (B.T.C.). Chemist, Boston Manufacturing Company, Waltham, Mass.

Bailey, Walter James, IV, '11 (D). Bailey's Cleansers and Dyers, Watertown, Mass.

Baker, William John, IV, '16 (D).

Baldwin, Arthur Lincoln, IV, '00 (D). Died December 1, 1919.

Baldwin, Frederick Albert, II, '04 (D). Vice-President and Secretary, Walter Blue & Co., Ltd., Sherbrooke, Que.

Ballard, Horace W. C. S., IV, '08 (D). Died September 28, 1918.

Barlofsky, Archie, VI, '17 (B.T.E.). Merchant, Economy Cash Market, 165 Chelmsford Street, Lowell, Mass.

Barr, I. Walwin, I, '00 (D). With American Bleached Goods Company, 39 Leonard Street, New York City.

Barrett, Andrew Edward, IV, '23 (B.T.C.). Color Chemist, Burson Knitting Company, Rockford, Ill.

Beck, Frederic Christian, II, '24 (D).

Bell, Edward Benjamin, IV, '24 (B.T.C.). With Craigleith Mills, Inc., Oakland, R. I.

Bennett, Edward Howard, II, '03 (C). Publisher, American Wool and Cotton Reporter, 530 Atlantic Avenue, Boston, Mass.

Bennett, Herbert Bowen, II, '13 (D). Died January 23, 1920.

Berry, Wilbur French, II, '17 (D). Manager and Treasurer, Wilbur Manufacturing Company, Providence, R. I.

Bienstock, George Jerrard, III, '24 (D). Designer, Superfine Textile Mills, New York City.

Bigelow, Prescott Fenno, II, '12 (D). Died October 14, 1918.

Bird, Clarence Henry, II, '22 (D). In Superintendent's Office, Worcester Woolen Mill Company, Worcester, Mass.

Bird, Francis John, VI, '22 (B.T.E.). 30 West Street, Attleboro, Mass.

Blaikie, Howard Mills, II, '11 (D). Assistant Styler and Salesman, American Woolen Company, 225 4th Avenue, New York City.

Blake, Parker Gould, VI, '14 (D). Manufacturers' Agent, Claude Denis & Co., Toronto, Ont.

Blanchard, John Lawrence, II, '23 (D). Assistant Designer, Everett Mills, Lawrence, Mass.

Bloom, Wilfred Nathaniel, IV, '03 (D). Died August 17, 1918.

Bodwell, Henry Albert, II, '00 (D). Treasurer and General Manager, Smith & Dove Manufacturing Company, Andover, Mass.

Booth, James Mooney, IV, '24 (B.T.C.). Harvard Business School, Cambridge, Mass.

Boyd, George Andrew, I, '05 (D). Assistant Treasurer, Harmony Mills, 201 Devonshire Street, Boston, Mass.

Boylston, Theodore Willmott, IV, '21 (B.T.C.). Died June 3, 1921.

Brackett, Martin Richard, II, '22 (D). With D. S. Mackay & Co., 215 Fourth Avenue, New York City.

Bradford, Roy Hosmer, II, '06 (D). Superintendent, Linen Thread Plant, Smith & Dove Manufacturing Company, Andover, Mass.

Bradley, Raymond Frost, VI, '14 (D). Garage Proprietor, Twin Light Garage Company, 267 East Main Street, Gloucester, Mass.

Bradley, Richard Henry, V, '01 (C). Overseer, Wamsutta Manufacturing Company, New Bedford, Mass.

Brainerd Arthur Travena, IV, '09 (D). Manager of Chicago office, H. A. Metz & Co., Inc., 449 North La Salle Street, Chicago, Ill.

Brainerd, Carl Emil, IV, '20 (B.T.C.). Overseer of Dyeing, F. C. Huyck & Sons, Albany, N. Y.

Brainerd, Carroll Lewis, IV, '19 (B.T.C.). With Waldrich Bleachery, Delawanna, N. J.

Brandt, Carl Dewey, VI, '20 (B.T.E.). Assistant Superintendent and Chemist, Lowell Bleachery, South Experiment, Ga.

Brannen, Leon Vincent III, '07 (C).

Brickett, Chauncy Jackson, II, '00 (D). Principal, School of Textiles, International Correspondence School, Scranton, Pa.

Brickett, Raymond Calvin, II, '14 (D). Overseer, M. T. Stevens & Sons Company (Marland Mills), Andover, Mass.

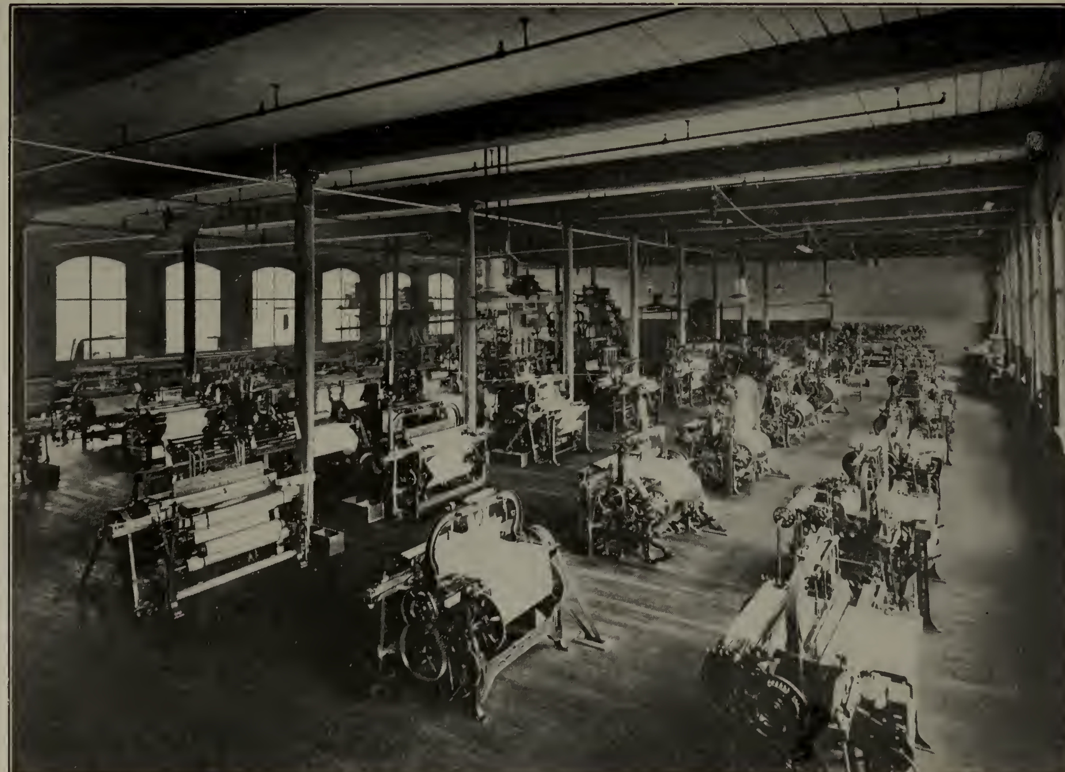
Brigham, Howard Mason, VI, '24 (B.T.E.). With Hunter Manufacturing and Commission Company, 60 Worth Street, New York City.

Brown, Gerald Marston, VI, '22 (B.T.E.). With Monomac Spinning Company, Lawrence, Mass.

Brown, Philip Franklin, II, '23 (D). Sales Department, DuPont Fibersilk Company, 132 Madison Avenue, New York City.

Brown, Rollins Goldthwaite, IV, '12 (D). Sales Executive, Nelson D. White & Sons, Winchendon, Mass.
Brown, Russell Lee, VI, '21 (B.T.E.). Assistant Superintendent, M. T. Stevens & Sons Co., Franklin, N. H.
Brown, Will George, Jr., IV, '22 (B.T.C.). Assistant Chemist, Lowell Bleachery, Lowell, Mass.
Buchan, Donald Cameron, II, '01 (D.) Assistant Superintendent, M. T. Stevens & Sons Company, North Andover, Mass.
Burbeck, Dorothy Maria, IV, '20 (B.T.C.). Chelmsford, Mass.
Burger, Samuel Joseph, III, '24 (D).
Burnham, Frank Erwin, IV, '02 (D). Dyer and Chemist, Black River Mill, Ludlow, Vt.
Burrage, Katharine C., IIIb '99 (C). Died May 16, 1914.

Cameron, Elliott Francis, IV, '11 (D). Treasurer, Amos F. Chase Company, Inc., 13 Otis Street, Boston, Mass.
Campbell, Alexander, VI, '23 (B.T.E.). Resident Engineer, John A. Stevens, Engineer, 904 Sun Building, Lowell, Mass.
Campbell, Laura Etta, IIIb '00 (C). Deceased. . . .
Campbell, Louise Porter, IIIb, '03 (C). With Ginn & Co., 15 Ashburton Place, Boston, Mass.
Campbell, Orison Sargent, II, '03 (D). Superintendent, Canadian Consolidated Felt Company, Ltd., Kitchener, Ont.
Cannell, Philip Stuart, VI, '23 (B.T.E.). Textile Engineer, Lockwood, Greene & Co., 24 Federal Street, Boston, Mass.
Carr, George Everett, I, '05 (D).
Carr, Paul Edward, II, '24 (D). With H. Haigh & Co., 246 Summer Street, Boston, Mass.
Carter, Robert Albion, IV, '02 (D). Assistant Sales Manager, E. I. du Pont de Nemours & Co., 126–128 South Front Street, Philadelphia, Pa.
Cary, Julian Clinton, VI, '10 (D). Branch Manager, American Mutual Liability Insurance Company, 209 Pearl Street, Hartford, Conn.
Caya, Ferdinand Joseph, IV, '22 (B.T.C.). Textile Colorist, National Aniline and Chemical Company, Boston, Mass.
Chamberlin, Frederick Ellery, I, '03 (D). Overseer of Spinning, Monument Mills, Housatonic, Mass.
Chandler, Proctor Ralph, IV, '11 (D). Manufacturer, Chandler Manufacturing Company, Weymouth, Mass.
Chang, Chi, VI, '23 (B.T.E.).
Chang, Wen Chuan, VI, '21 (B.T.E.). Dah Sung Cotton Mill No. 1, Nantung, Kiangsu, China.
Chapman, Leland Hildreth, VI, '24 (B.T.E.) Instructor, Townsend High School, Townsend, Mass.
Chen, Shih Ching, IV, '22 (B.T.C.). Hou Sung Cotton Mill, Shanghai, China.
Chen, Wen-Pei, IV, '24 (B.T.C.)
Chisholm, Lester Bury, I, '11 (D). Assistant General Manager, Everlastik, Inc., Chelsea, Mass.
Church, Charles Royal, II, '06 (C.) Teacher, Santa Monica High School, Santa Monica, Calif.
Churchill, Charles Whittier, III, '06 (D). Manager, Churchill Manufacturing Company, Inc., Lowell, Mass.
Clapp, Frank Austin, II, '04 (D). Selling Agent, South Bend Woolen Mills, Inc., 215 4th Avenue, New York City.
Clark, Earl William, IV, '18 (B.T.C.). 29 Duane Avenue, La Salle, N. Y.
Clark, Thomas Talbot, II, '10 (D). Treasurer, Talbot Mills, North Billerica, Mass.
Clarke, George Dean, II, '21 (C). With Franklin Process Company, 564 Eddy Street, Providence, R. I.
Clayton, Harold Edmund, VI, '21 (B.T.E.). Assistant Superintendent, International Worsted Mills, Methuen, Mass.



Weave Room

Cleary, Charles Joseph, II, '13 (D). Chief. Textile and Rubber Branch, Engineering Division, United States Army Air Service, McCook Field, Dayton, Ohio.

Clement, David Scott, IV, '24 (B.T.C.). With Braemor Mills, Inc., Pascoag, R. I.

Clifford, Albert Chester, VI, '22 (B.T.E.). 35 Ainsworth Street, Roslindale, Mass.

Clogston, Raymond B., IV, '04 (D). Superintendent of Dyeing, Merrimack Manufacturing Company, Lowell, Mass.

Coan, Charles Bisbee, IV, '12 (D). Dye Demonstrator, Jennings & Co., 93 Broad Street, Boston, Mass.

Cohen, Arthur Edward, IV, '23 (B.T.C.).

Colby, James Tracy, VI, '16 (D). Salesman, F. C. Huyck & Sons, Albany, N. Y.

Cole, Edward Earle, IV, '06 (D). Reporter, The Bradstreet Company, Haverhill, Mass.

Cole, James Thomas, II, '05 (D). Treasurer, Arlington Industries for the Blind, Arlington, Mass.

Collonan, Herbert Joseph, II, '22 (D). Assistant Designer, Beoli Mills, Fitchburg, Mass.

Coman, James Groesbeck, I, '07 (D). Manager, Tipton Cotton Mills, Covington, Tenn.

Conant, Harold Wright, I, '09 (D). Treasurer and Manager, Conant, Houghton & Co., Inc., Littleton, Mass.

Conant, Richard Goldsmith, I, '12 (D). Sales Executive, Brighton Mills, Passaic, N. J.

Conklin, Jennie Grace, IIIb, '05 (C). See Nostrand, Mrs. William L.

Cook, Kenneth Bartlett, I, '13 (D). Manager, United States Rubber Company, 122 Adams Street, Newark N. J.

Cosendai, Edwin Frederick Ernest, IV, '15 (B.T.D.). Died November 1, 1923.

Craig, Albert Wood, IV, '07 (D). Superintendent, Windsor Print Works, North Adams, Mass.

Craig, Clarence Eugene, III, '02 (D). Farming, Derry, N. H.

Creese, Guy Talbot, IV, '14 (D). Chemist, Creese & Cook Company, Danversport, Mass.

Culver, Ralph Farnsworth, IV, '04 (D). Vice-President and Manager, Providence Office, Ciba Company, Inc., 61 Peck Street, Providence, R. I.

Cummings, Edward Stanton, VI, '16 (D). Cotton Tester, United States Department of Agriculture, Clemson College, S. C.

Curran, Charles Ernest, III, '02 (C). Head Designer, Wood Worsted Mills, Lawrence, Mass.

Currier, Herbert Augustus, I, '06 (D). Manager, New York Yarn Department, Wm. Whitman Company, Inc., 25 Madison Avenue, New York City.

Currier, John Alva, II, '01 (D). Superintendent, Pentucket Mills (M. T. Stevens & Sons Company), Haverhill, Mass.

Curtis, Frank Mitchell, I, '06 (D). Lumber Merchant, Wm. Curtis Sons Company, 30 Eustis Street, Roxbury, Mass.

Curtis, William Leavitt, II, '05 (C).

Cutler, Benjamin Winthrop, Jr., III, '04 (D).

Cuttle, James H., II, '99 (D).

Dalton, Gregory Smith, IV, '12 (D).

Datar, Anant Vithal, VI, '24 (B.T.E.). Inchalkaranji (S. M. Cy), India.

Davieau, Alfred Edward, VI, '16 (D). United States Testing Company, Inc., 316 Hudson Street, New York City.

Davieau, Arthur Napoleon, VI, '13 (D). Superintendent, Kenwood Mills, Ltd., (F. C. Huyck & Sons), Arnprior, Ont.

Davieau, Leon Arthur, VI, '23 (B.T.E.). With Pacific Mills, Lawrence, Mass.

Davis, Alexander Duncan, VI, '14 (B.T.E.). Instructor, Northeastern University, Springfield, Mass.

Dearborn, Roy, VI, '13 (D). Purchasing Agent, Brightwood Manufacturing Company, North Andover, Mass.

Dearth, Elmer Ellridge, IV, '12 (D). Assistant to Factory Manager. The Federal Rubber Company, Cudahy, Wis.

Derby, Roland Everett, IV, '22 (B.T.C.). Dyer, Lowell Dye Works, Lowell, Mass.

de Sa, Francisco, VI, '18 (B.T.E.). Avenue da Graca, Bahia, Brazil.

Dewey, James French, II, '04 (D). Vice-President and Superintendent, A. G. Dewey Company, Quechee, Vt.

Dewey, Maurice William, II, '11 (D). Inspector of Real Estate and Real Estate Loans, National Life Insurance Company, Montpelier, Vt.

Dillon, James Henry, III, '05 (D). Land Developing and Colonizing, 512 Summer Building, St. Petersburg, Fla.

Donald, Albert Edward, II, '04 (D). Agent, Hecla Mill (American Woolen Company), Uxbridge, Mass.

Donovan, Joseph Richard, IV, '24 (B.T.C.). Chemist and Dyer, Thomas Dalby Company, Watertown, Mass.

Doran, Wilbur Kirkland, II, '22 (D). Teacher, Manchester High School, Manchester, N. H.

Dorr, Clinton Lamont, VI, '14 (D). With Raymond Syndicate, 356 Washington Street, Boston, Mass.

Douglas, Walter Shelton, II, '21 (D). 12 Bertram Street, Lowell. Mass.

Duguid, Harry Wyatt, I, '24 (D). Assistant Superintendent, Maverick Mills, East Boston, Mass.

Dunnican, Edward Tunis, VI, '24 (B.T.E.). Second Hand, Pacific Mills, Lawrence, Mass.

Durgin, William Ernest, IV, '24 (B.T.C.). Textile Chemist, Geigy & Co., Inc., 88 Broad Street, Boston, Mass.

Duval, Joseph Edward, II, '10 (D). Yarn Dealer, 308 Chestnut Street, Philadelphia, Pa.

Dwight, John Francis, Jr., II, '08 (D). Proprietor, Humarock Inn, Humarock, Mass.

Echmalian, John Gregory, VI, '16 (B.T.E.). With Cheney Brothers, So. Manchester, Conn.

Ehrenfried, Jacob Benjamin, II, '07 (C). With George Ehrenfried Company, Lewiston, Me.

Elliot, Gordon Baylies, II, '12 (D). In Charge of Production, Reed & Prince Manufacturing Company, Worcester, Mass.

Ellis, Charles Albert, VI, '21 (B.T.E.). In Charge of Development Work, Lamson Company, 3413 James Street, Syracuse, N. Y.

Emerson, Frank Warren, II, '03 (D). Agent, Standish Worsted Company, Penacook, N. H.

Engstrom, Karl Emil, VI, '12 (D).

Enloe, Winfred Paige, I, '22 (D). Assistant Superintendent, W. A. Handley Manufacturing Company, Roanoke, Ala.

Evans, Alfred Whitney, III, '03 (D).

Evans, William Robinson, III, '03 (D). 309 Main Street, Bradford, Mass.

Everett, Charles Arthur, IV, '19 (B.T.C.). Instructor, Dyeing Department, Lowell Textile School, Lowell, Mass.

Ewer, Nathaniel Trull, IV, '01 (D). Chemist, American Dyewood Company, Chester, Pa.

Fairbanks, Almonte Harrison, II, '09 (D). Treasurer, Middlesex Knitting Company, Wakefield, Mass.

Farmer, Chester Jefferson, IV, '07 (D). Professor of Chemistry, Northwestern Medical School, Chicago, Ill.

Farnsworth, Harold Vincent, VI, '16 (B.T.E.). Textile Engineer, with Atkinson, Haserick & Co., 152 Congress Street, Boston, Mass.

Farr, Leonard Schaefar, II, '08 (D). Assistant Superintendent, No. 2 Mill, Farr Alpaca Company, Holyoke, Mass.

Farwell, Claude Chapman, VI, '23 (B.T.E.). With Proctor & Schwartz, Inc., Philadelphia, Pa.

Farwell, Ray Baldwin, VI, '24 (B.T.E.). With Belmont Hosiery Company, Belmont, N. H.

Feindel, George Paul, IV, '24 (B.T.C.). In charge of Dyehouse and Laboratory, Burson Knitting Company, Rockford, Ill.

Feldstein, Martin Alexander, VI, '24 (B.T.E.). Assistant to Production Manager, National Airphone Company, 16 Hudson Street, New York City.

Fels, August Benedict, II, '99 (D).

Ferguson, Arthur Feiling, I, '03 (D). With United States Tariff Commission, Washington, D. C.

Ferguson, William Gladstone, III, '09 (D). Manager, Efficiency Department, Ludlow Manufacturing Associates, Ludlow, Mass.

Finlay, Harry Francis, IV, '10 (D). Color Chemist, National Aniline and Chemical Company, Boston, Mass.

Fisher, Russell Todd, VI, '14 (D). Technical Secretary, National Association of Cotton Manufacturers, 80 Federal Street, Boston, Mass.

Fiske, Starr Hollinger, II, '09 (D). Superintendent, Wachusett Mills and E. J. Hylan Textile Company, Lowell, Mass.

Fitzgerald, John Francis, IV, '18 (B.T.C.). Dyer, Boston Dye House, Malden, Mass.

Fleischmann, Meyer, IV, '20 (B.T.C.). Chief Chemist, Real Silk Hosiery Mills, Indianapolis, Ind.

Fleming, Frank Everett, IV, '06 (D). Assistant Dyer and Finisher, Goodall Worsted Company, Sanford, Me.

Fletcher, Roland Hartwell, VI, '10 (D). With Pressed Steel Car Company, McKees Rocks, Pa.

Flynn, Thomas Patrick, IV, '11 (D). Salesman, American Aniline Products, Inc., 77 Bedford Street, Boston, Mass.

Ford, Edgar Robinson, IV, '11 (D). Finisher, Sayles Finishing Plants, Saylesville, R. I.

Forsaith, Charles Henry, VI, '20 (B.T.E.). Superintendent, Nashua Manufacturing Company (Jackson Mills), Nashua, N. H.

Forsaith, Ralph Allen, VI, '16 (B.T.E.). Assistant Superintendent, Appleton Company, Lowell, Mass.

Forsyth, Harold Downes, VI, '23 (B.T.E.). Secretary of the Corporation, Wm. Forsyth & Sons Co., Lynn, Mass.

Foster, Boutwell Hyde, VI, '17 (B.T.E.). Textile Engineer, Textile Section, United States Rubber Company, 122 Adams Street, Newark, N. J.

Foster, Clifford Eastman, II, '01 (D). Manager, Phoenix Mills, Millbury, Mass.

Fowle, Edwin Daniels, VI, '24 (B.T.E.). Editorial Department, "Textile World," 65 Franklin Street, Boston, Mass.

Frost, Harold Benjamin, II, '12 (D). Mill Superintendent, Newichawanick Company, South Berwick, Me.

Fuller, Allen Reed, IV, '17 (B.T.C.). Chemist, Bliss, Fabyan Company, Three Rivers, Mass.

Fuller, George, I, '03 (D). Cotton Goods Technologist and Styler, J. P. Stevens & Company, New York City.

Gadsby, Arthur Norton, II, '13 (D). Worsted Employment Manager, Pacific Mills, Lawrence, Mass.

Gahm, George Leonhard, II, '06 (D). Superintendent, Yarn Department, Wood Worsted Mills, Lawrence, Mass.

Gainey, Francis William, IV, '11 (D). Colorist, E. I. du Pont de Nemours & Co., Wilmington, Dela.

Gale, Harry Laburton, III, '10 (D). Manager, Styling and Designing Department, Hunter Manufacturing and Commission Company, 58 Worth Street, New York City.

Gay, Olin Dow, II, '08 (D). Superintendent of Woolen Mill, Gay Brothers Company, Cavendish, Vt.
Gerrish, Henry Kilborn, III, '16 (D). Died September 18, 1922.
Gerrish, Walter, III, '03 (D). Director of Occupational Therapy, Devereaux Mansion, Inc., Marblehead, Mass.
Gillie, Stanley James, I, '22 (D). With United States Testing Company, Inc., New York City.
Gillon, Sara Agnes, IIIb, '06 (C).
Goldberg, George, VI, '10 (D). Manufacturer, Liberty Lace and Braid Company, 88 Bedford Street, Boston, Mass.
Goldman, Moses Hyman, IV, '20 (B.T.C.).
Goller, Harold Poehlmann, II, '23 (D). Salesman, du Pont Fibersilk Company, 132 Madison Avenue, New York City.
Goodhue, Amy Helen, IIIb, '00 (C). See Harrison, Mrs. Arthur.
Gooding, Francis Earle, IV, '19 (B.T.C.). Night Superintendent, Chipman Chemical Engineering Company, Bound Brook, N. J.
Goosetrey, Arthur, IV, '21 (B.T.C.).
Goosetrey, John Thomas, IV, '21 (B.T.C.). Dyer and Chemist, Rhode Island Lace Company, West Barrington, R. I.
Gould, Norman Culver, VI, '19 (B.T.E.). Textile Engineer, F. C. Huyck & Sons, Albany, N. Y.
Greenberg, Archie, II, '21 (D). Textile Expert, Hart, Schaffner & Marx, Chicago, Ill.
Gyzander, Arne Kolthoff, IV, '09 (D). Chemist, National Aniline and Chemical Company, 113 High Street, Boston, Mass.

Haddad, Nassib, VI, '23 (B.T.E.). Box 14, Iselin, N. J.
Hadley, Richard Francis, IV, '22 (B.T.C.). Salesman, Carbon, Coal & Coke Company, 85 Devonshire Street, Boston, Mass.
Hadley, Walter Eastman, IV, '08 (D). Chief Chemist, The Clark Thread Company, Newark, N. J.
Hadley, Wilfred Nourse, II, '22 (D). With Parks & Woolson Company Springfield, Vt.
Hager, Hazen Otis, II, '21 (C). Assistant Superintendent and Designer, Anderson Mills, Skowhegan, Me.
Hall, Frederick Kilby, VI, '24 (B.T.E.). With Stirling Mills, Lowell, Mass.
Halsell, Elam Ryan, I, '04 (C).
Hammond, Chester Twombly, II, '23 (D). Assistant to Wool Buyer, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.
Hardie, Newton Gary, I, '23 (D). Assistant Cost Man, Judson Mills, Greenville, S. C.
Hardy, Philip Lewis, VI, '10 (D). Contractor, Andover, Mass.
Harmon, Charles Francis, I. '99 (D). 86 Kingsland Avenue, Elmhurst, L. I.
Harrington, Thomas, IV, '15 (D). Superintendent, Monarch Leather Company, 1127 West Division Street, Chicago, Ill.
Harris, Charles Edward, I, '05 (D). General Manager, The Harris Company, Easthampton, Mass.
Harris, George Simmons, I, '02 (C). President and Manager, Exposition Cotton Mills, Atlanta, Ga.
Harrison, Mrs. Arthur (Goodhue, Amy Helen), IIIb, '00 (C). R.F.D. No. 2, Lowell, Mass.
Hart, Arthur Norman, IV, '19 (B.T.C.).
Hart, Howard Roscoe, I, '23 (D). With Mohawk Carpet Company, Amsterdam, N. Y.
Haskell, Spencer Howard, II, '07 (D). 56 Grove Street, Worcester, Mass.
Haskell, Walter Frank, IV, '02 (D). Overseer of Dyeing, Dana Warp Mills, Westbrook, Me.
Hassett, Paul Joseph, IV, '12 (D). With E. S. Twining & Co., 93 Worth Street, New York City.
Hathorn, George Wilmer, IV, '07 (D). Chemist, Lawrence Gas Company, Lawrence, Mass.

Hathorne, Berkeley Lewis, IV, '24 (B.T.C.). With Felters Company, Millbury, Mass.

Hay, Ernest Crawford, II, '11 (D). Superintendent, Monomac Spinning Company, Lawrence, Mass.

Hendrickson, Walter Alexander, II, '11 (D). With National Knitting Company, 905 Clinton Street, Milwaukee, Wis.

Hennigan, Arthur Joseph, II, '06, (D). President, Seneca Manufacturing Company, and New England Representative, Cox & Schreiber, of New York, 31 Bedford Street, Boston, Mass.

Hildreth, Harold William, II '07 (D). Granite Dealer, Westford, Mass.

Hillman, Ralph Greeley, VI, '22 (B.T.E.). Assistant Superintendent, Samson Cordage Works, Shirley, Mass.

Hintze, Thomas Forsyth, I, '06 (C). 216 East 20th Street, Tulsa, Okla.

Hodge, Harold Bradley, VI, '22 (B.T.E.). With J. C. and W. T. Monahan, Civil Engineers and Surveyors, 219 Central Street, Lowell, Mass.

Hoffman, Richard Robert, II, '21 (C). Assistant Designer, Beoli Mills, Fitchburg, Mass.

Holden, Francis Crawford, IV, '09 (D). Chemist, Chelsea Fiber Mills, 1155 Manhattan Avenue, Brooklyn, N. Y.

Holden, John Sanford, II '20 (D). Manufacturer, Automatic Machine Products' Company, Attleboro, Mass.

Holgate, Benjamin, III, '02 (C). Agent, Boott Mills, Lowell, Mass.

Hollings, James Louis, I, '05 (D). Buyer and Converter (Cotton Goods), W. R. Grace & Co., 7 Hanover Square, New York City.

Holmes, Otis Milton, VI, '13 (B.T.E.). Draftsman, United Shoe Machinery Corporation, Beverly, Mass.

Hood, Leslie Newton, IV, '12 (D). Chemist, Cheney Brothers, South Manchester, Conn.

Hook, Russell Weeks, IV, '05 (D). Chemist in charge of Textile Department, Arthur D. Little, Inc., 30 Charles River Road, Cambridge, Mass.

Horne, James Albert, I, '24 (D).

Horsfall, George Gordon, II, '04 (C). Assistant Dyer, Interwoven Mills, Inc., Martinsburg, W. Va.

Horton, Chester Temple, VI, '14 (B.T.E.). Wilmington, Mass.

Houghton, Robert Kingsbury, IV, '23 (B.T.C.). Assistant Chemist, Bradford Dyeing Association, Bradford, R. I.

Howarth, Charles Lincoln, IV, '17 (B.T.C.). Assistant Professor of Dyeing, Lowell Textile School, Lowell, Mass.

Howe, Woodbury, Kendall, I, '10 (D). Assistant Superintendent, Merrimack Manufacturing Company, Lowell, Mass.

Hoyt, Charles William Henry, IV, '07 (D).

Hsu, Hsueh-Chang, VI, '23 (B.T.E.). 512 West 122d Street, New York City.

Hubbard, Harold Harper, I, '22 (D). Overseer, Royal River Manufacturing Company, Yarmouth, Me.

Hubbard, Ralph King, IV, '11 (D). Treasurer and Agent, Packard Mills, Inc., Webster, Mass.

Huising, Gerônimo Huerva, I, '08 (D). With San Augustin Plantation Company, San José, Mindoro, P. I.

Hunt, Chester Lansing, III, '05 (C).

Hunton, John Horace, II, '11 (D). Treasurer and General Manager, Newichawanick Company, South Berwick, Me.

Hurtado, Leopoldo, Jr., VI, '10 (D). General Manager, Hurtado & Co., Uruapan, Michoacán, Mex.

Hurwitz, Jacob, IV, '23 (B.T.C.).

Hutton, Clarence, III, '03 (C.) Editor, "Textile World," 65 Franklin Street, Boston, Mass.

Irvine, James Andrew, VI, '17 (B.T.E.). Educational Director, Cheney Brothers, South Manchester, Conn.

Jaeger, Robert William, Jr., IV, '23 (B.T.C.). Chemist, James & E. H. Wilson, Inc. (Taconic Woolen Mill), Pittsfield, Mass.

Jelleme, William Oscar, I, '10 (D). With Cohn-Hall-Marx Company, 93 Franklin Street, New York City.

Jen, Shang Wu, I, '21 (D).

Jenckes, Leland Aldrich, VI, '08 (D). Deceased.

Jessop, Charles Clifford, VI, '22 (B.T.E.). With Mohawk Carpet Mills, Inc., Amsterdam, N. Y.

Johnson, Arthur Kimball, IV, '13 (D) (B.S. 1917, Massachusetts Institute of Technology). Instructor in Chemistry, Lowell Textile School, Lowell, Mass.

Johnson, George Henry, IV, '20 (B.T.C.). Director of Research, Laundry Owners National Association, Mellon Institute, University of Pittsburgh, Pittsburgh, Pa.

Johnson, Philip Stanley, IV, '24 (B.T.C.).

Jones, Everett Amos, III, '05 (D). Superintendent and Secretary, Nye & Wait Kilmarnock Corporation, Auburn, N. Y.

Jones, Nathaniel Erskine, I, '21 (D). Overseer, Renfrew Manufacturing Company, Adams, Mass.

Jury, Alfred Elmer, IV, '04 (D). Director, General Laboratories and Textile Section, United States Rubber Company, 561 West 58th Street, New York City.

Kaatze, Julius, VI, '22 (B.T.E.). Salesman, Toledo Scale Company. Lawrence, Mass.

Kao, Chieh-Ching, VI, '23 (B.T.E.).

Karanfilian, John Hagop, VI, '21 (B.T.E.). 5508 Chester Avenue, West Philadelphia, Pa.

Kay, Harry Pearson, II, '09 (D). New England Agent, S. Slater & Sons, Inc., 115 Chauncy Street, Boston, Mass.

Kendall, Charles Henry, II, '23 (D). Assistant Superintendent and Designer, Bridgewater Woolen Company, Bridgewater, Vt.

Kent, Clarence LeBaron, III, '06 (C). Station Agent, Standard Oil Company, Rochester, N. H.

Keough, Wesley Lincoln, II, '10 (D). Salesman, B. O. Kendall Company, 67 North Raymond Avenue, Pasadena, Calif.

Kingsbury, Percey Fox, IV, '01 (D). Print Manager, Passaic Print Works, Passaic, N. J.

Knowland, Daniel Power, IV, '07 (D). Chemist, Geigy Company, Inc., 89 Barclay Street, New York City.

Knox, Joseph Carleton, VI, '23 (B.T.E.). Assistant Foreman, Insulating Department, Simplex Wire and Cable Company, East Cambridge, Mass.

Lakeman, Fannie Shillaber, IIIb, '00 (C). Died February 8, 1921.

Lamb, Arthur Franklin, II, '10 (D). In business, cleansing and dyeing, 297 Main Street, Rockland, Me.

Lamont, Robert Laurence, II, '12 (D).

Lamprey, Leslie Balch, IV, '16 (B.T.D.). 173 Parker Street, Lawrence, Mass.

Lamson, George Francis, I, '00 (D). With Ludlow Manufacturing Associates, Ludlow, Mass.

Lane, John William, I, '06 (C).

Lane, Oliver Fellows, IV, '15 (B.T.D.). Chemist, Head of Color Making Department, Lowe Paper Company, Ridgefield, N. J.

Larratt, John Francis, II, '22 (D). Assistant Overseer, Kinney Worsted Yarn Company, Pittsfield, Mass.

Laughlin, James Knowlton, III, '09 (D).

Laurin, Eric Thursten Lawrence, IV, '21 (B.T.C.). Chemist, Sayles Finishing Plant, Saylesville, R. I.

Laurin, Sven Albert, IV, '23 (B.T.C.). Assistant Colorist, Fiberloid Corporation, Indian Orchard, Mass.

Leach, John Pelopidas, I, '00 (C). Farming, Littleton, N. C.

Lee, William Henry, II, '05 (C). Treasurer, Lee's Wool Shop, 207 Pine Street, Holyoke, Mass.

Leitch, Harold Watson, IV, '14 (B.T.D.). Chemical Engineer, M. T. Stevens & Sons Co., Franklin, N. H.

Lemire, Joseph Emile, VI, '21 (B.T.E.). Builder and Realtor, St. Pierre & Bergeron, Lowell, Mass.

Levi, Alfred Sandel, IV, '09 (D). Vice-President, Liondale Bleach, Dye and Print Works, Rockaway, N. J.

Lewis, George Kenneth, VI, '24 (B.T.E.). Overseer, Jackson Mills (Nashua Manufacturing Company), Nashua, N. H.

Lewis, LeRoy Clark, IV, '08 (D). Raw Silk Inspector, Henry Doherty Silk Company, Clifton, N. J.

Lewis, Walter Scott, IV, '05 (D). Special Expert in Textiles, United States Tariff Commission, Washington, D. C.

Lillis, Marvin Hale, IV, '14 (D). With Marland Mills, Andover, Mass.

Lombard, Carleton Joshua, VI, '23 (B.T.E.). With Curtis & Marble Machine Company, Worcester, Mass.

Loney, Robert William, II, '22 (D). Foreman, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.

Longbottom, Parker Wyman, IV, '21 (B.T.C.). Color Chemist, Watson Park Company, 165 High Street, Boston, Mass.

Lowe, Philip Russell, VI, '24 (B.T.E.). With Smith & Dove Manufacturing Company, Andover, Mass.

Lucey, Edmund Ambrose, II, '04 (D). President. Wm. A. Tottle & Co., Inc., Baltimore, Md.

McCann, John Joseph, Jr., VI, '24 (B.T.E.).

McCool, Frank Leslie, IV, '10 (D). Vice-President, S. R. David & Co., Inc., 252 Congress Street, Boston, Mass.

Macdonald, Hector Graham, IV, '19 (B.T.C.). Overseer of Dyeing. Pitman Manufacturing Company, Laconia, N. H.

McDonnell, William Henry, I, '06 (C). Lawyer, McDonnell, Drew & White, 40 Court Street, Boston, Mass.

McGowan, Frank Robert, VI, '15 (B.T.E.). Textile Engineering and Research, 526 Transportation Building, Washington, D. C.

McGowan, Henry Earl, VI, '22 (B.T.E.). Instructor, Lowell High School, Lowell, Mass.

Mackay, Stewart, III, '07 (D). Assistant Professor of Textile Design, Lowell Textile School, Lowell, Mass.

McKenna, Hugh Francis, IV, '05 (D). Western Manager, United Indigo and Chemical Company, Ltd., 218 West Kinzie Street, Chicago, Ill.

MacPherson, Wallace Angus, III, '04 (D). Designer, Wuskanut Mills (S. Slater & Sons, Inc.), Farnumsville, Mass.

Macher, Henry, II, '23 (D). With United Wool Finishing & Dyeing Company, Passaic, N. J.

Mahoney, George Stephen, VI, '22 (B.T.E.). With the Appleton Mills, Lowell, Mass.

Mailey, Howard Twisden, II, '08 (D). Assistant Superintendent, Worsted Department, Pacific Mills, Lawrence, Mass.

Manning, Frederick David, IV, '10 (D). Engineer, Sanderson & Porter, 52 William Street, New York City.

Marcoglou, Aristides Sawa, VI, '22 (B.T.E.). 15 Abdine Street, Cairo, Egypt.

Marinel, Walter Newton, I, '01 (D). Automobile Repairing, North Chelmsford, Mass.

Marshall, Chester Stanley, II, '22 (D). With Wood Mill, Lawrence, Mass.

Martin, Harry Warren, IV, '11 (D). Divisional Manager, Hood Rubber Company, Watertown, Mass. . . . .

Mason, Archibald Lee, VI, '09 (D).

Mather, Harold Thomas, VI, '13 (D). Salesman, John V. Farwell Company, 43 Kingston Street, Boston, Mass.

Mathieu, Alfred Jules, II, '20 (D). Superintendent of Combing, French Worsted Company, Woonsocket, R. I.

Matthews, Elmer Clark, II, '17 (D). Superintendent, Thermo Mills, Inc., West Sand Lake, N. Y.

Mauersberger, Herbert Richard Carl, III, '18 (D). Instructor and Lecturer, Textile Shop, Public School No. 12, Passaic, N. J.

Meadows, William Ransom, I, '04 (D). Cotton Registrar and Member of Chicago Board of Trade, 141 West Jackson Boulevard, Chicago, Ill.

Meek, Lotta, IIIb, '07 (C). See Parker, Mrs. Herbert L.

Merchant, Edith Clara, IIIb, '00 (C). Supervisor of Drawing, Lowell, Mass.

Merrill, Allan Blanchard, IV, '11 (D). Development Engineer, B. F. Goodrich Rubber Company, Akron, Ohio.

Merrill, Gilbert Roscoe, VI, '19 (B.T.E.). Assistant Professor, Cotton Yarns and Knitting, Lowell Textile School, Lowell, Mass.

Merriman, Earl Cushing, II, '07 (D). Died September 30, 1918.

Midwood, Arnold Joseph, IV, '05 (D). Salesman, Dyestuffs Corporation of America, 281 Franklin Street, Boston, Mass.

Miller, Joshua, VI, '24 (B.T.E.). 342 Park Street, Dorchester, Mass.

Minge, Jackson Chadwick, I, '01 (C). Treasurer, M. K. Gray, Inc., 424 West 33d Street, New York City.

Mirsky, Leon Robert, II, '19 (D). Cloth Inspector, Navy Supply Depot, Brooklyn, N. Y.

Mitchell, Charles Alvah, II, '24 (D). Assistant to Superintendent, Newichawanick Company, South Berwick, Me.

Moller, Ernest Arthur, II, '22 (D). Salesman, the Flintkote Company, 809 Park Square Building, Boston, Mass.

Molloy, Francis Henry, II, '16 (D). Assistant Designer, Assabet Mill (American Woolen Company), Maynard, Mass.

Moore, Everett Byron, I, '05 (D). President and Assistant Treasurer, Chadbourne & Moore, Inc., Chelsea, Mass.

Moore, Karl Remick, IV, '11 (D). Chemical Engineer, Stillwater Worsted Mills, Harrisville, R. I.

Moore, William Joseph, IV, '21 (B.T.C.). Chemist, Pacific Mills, Lawrence, Mass.

Moorhouse, William Roy, IV, '01 (D). Resident Manager, Boston Branch, National Aniline and Chemical Company, Inc., 113 High Street, Boston, Mass.

Morrill, Howard Andrew, VI, '16 (D). Assistant Agent, Pepperell Manufacturing Company, Biddeford, Me.

Morris, Merrill George, IV, '21 (B.T.C.). Dyer, Nassau Felt Mills, Brooklyn, N. Y.

Morrison, Fred Clifton, I, '03 (D). Died August 21, 1919.

Mullaney, John Francis, VI, '20 (B.T.E.). With Saco-Lowell Shops, Lowell, Mass.

Mullen, Arthur Thomas, II, '09 (D). Designer and Assistant Superintendent, Mayo Woolen Mills Company, Millbury, Mass.

Munroe, Sydney Philip, I, '12 (D). Southern Manager, Ralph E. Loper & Co., Greenville, S. C.

Murray, James, IV, '13 (D). Chief Chemist, Appleton Coated Paper Company, Appleton, Wis.

Murray, James Andrew, II, '10 (D). With H. P. Murray Company, Inc., 224 Commercial Street, Boston, Mass.

Najar, G. George, IV, '03 (D). Overseer of Dyeing, Monument Mills, Housatonic, Mass.

Nary, James Anthony, II, '22 (D). Assistant Fabric Expert, United States Testing Company, New York City.

Nelson, Roy Clayton, II, '21 (C). Designer, Assabet Mills, Maynard, Mass.

Nelson, Russell Sprague, VI, '22 (B.T.E.). With Draper Corporation, Hopedale, Mass.

Wool Combing

Neugroschl, Sigmond Israel, I, '21 (D). Manager, Western Furniture Company, 874 South Vermont Avenue, Los Angeles, Calif.

Newall, John Douglas, IV, '09 (D). Division Superintendent, Arnold Print Works, North Adams, Mass.

Newcomb, Guy Houghton, IV, '06 (C). Assistant Manager, Dyestuff Department, E. I. du Pont de Nemours & Co., 1114 Union Trust Building, Chicago, Ill.

Neyman, Julius Ellis, IV, '15 (B.T.D.). Furniture Dealer, Neyman Furniture Company, 197–199 Middlesex Street, Lowell, Mass.

Nichols, Raymond Elmore, VI, '10 (D). With Farwell Bleachery, Lawrence, Mass.

Niven, Robert Scott, VI, '12 (D). Draftsman, General Electric Company, Lynn, Mass.

Nostrand, Mrs. William L. (Conklin, Jennie Grace), IIIb, '05 (C). 35 87th Street, Bay Ridge, Brooklyn, N. Y.

O'Brien, Philip Francis, II, '15 (D). Instructor, New York Textile High School, New York City.

O'Connell, Clarence Edward, IV, '11 (D). Dyer, National Aniline and Chemical Company, Buffalo, N. Y.

O'Connor, Lawrence Dennis, VI, '17 (D). With Beggs & Cobb, Winchester, Mass.

O'Donnell, John Delaney, I, '04 (C).

O'Hara, William Francis, IV, '04 (C). Superintendent, National Oil Products Company, Harrison, N. J.

Olson, Carl Oscar, II, '24 (D). With Talbot Mills, North Billerica, Mass.

Orr, Andrew Stewart, IV, '22 (B.T.C.). With Cherry & Webb, Lowell, Mass.

Othote, Louis Joseph, I, '23 (D). With B. B. & R. Knight, Arctic, R. I.

Palais, Samuel, IV, '18 (B.T.C.). Overseer, Bleaching and Dyeing, Peerless Knitting Mills Company, Barre, Vt.

Parker, B. Moore, I, '01 (D.) Died December 11, 1918.

Parker, Everett Nichols, I, '05 (D). President, Parker Spool and Bobbin Company, 27–53 Middle Street, Lewiston, Me.

Parker, Harry Carmi, III, '00 (C). 144 Berkeley Street, Boston, Mass.

Parker, Mrs. Herbert L. (Meek, Lotta L.), IIIb, '07 (C). 4 Brookside Circle, Auburn, Me.

Parker, Hubert Frederic, VI, '20 (B.T.E.). Draftsman, John A. Stevens, Engineer, 904 Sun Building, Lowell, Mass.

Parkis, William Lawton, I, '09 (D). Investigator, Cheney Brothers, South Manchester, Conn.

Peabody, Roger Merrill, II, '16 (D). Textile Superintendent, Industrial Fiber Company, Cleveland, Ohio.

Pearson, Alfred Henry, IV, '11 (D). Salesman, Ciba Company, Inc., 93 Broad Street, Boston, Mass.

Pease, Chester Chapin, I, '09 (D). Superintendent, Columbian Manufacturing Company, Greenville, N. H.

Peck, Carroll Wilmot, IV, '13 (D). With George Mann & Co., Inc., 251 Tockwotton Street, Providence, R. I.

Pensel, George Robert, IV, '13 (B.T.D.). Vice-President, Ritter Chemical Company, Inc., Amsterdam, N. Y.

Perkins, John Edward, III, '00 (D). Superintendent, S. N. & C. Russell Manufacturing Company, Pittsfield, Mass.

Perkins, Joshua Dean, III, '08 (D). Overseer, Amoskeag Manufacturing Company, Manchester, N. H.

Perlman, Samuel, IV, '17 (B.T.C.).

Perlmuter, Barney Harold, IV, '23 (B.T.C.). Credit Manager, American Furniture Company, Boston, Mass.

Petty, George Edward, I, '03 (C). With Jefferson Standard Life Insurance Company, Greensboro, N. C.

Phaneuf, Maurice Philippe, III, '20 (D). Assistant Styler, Guerin Mills, Inc., Woonsocket, R. I.

Pillsbury, Ray Charles, I, '13 (D). Superintendent of Weaving, Cheney Brothers, South Manchester, Conn.

Plaisted, Webster E., II, '18 (D). Superintendent, John and James Dobson, Inc., Philadelphia, Pa.

Plummer, Elliot Barton, IV, '13 (D). Died January 14, 1919.

Potter, Carl Howard, I, '09 (D). With Frank W. Van Ness, Passaic, N. J.

Pottinger, James Gilbert, II, '12 (D). Grey Goods Buyer, S. Slater & Sons, Inc., 21 East 26th Street, New York City.

Powers, Walter Wellington, IV, '20 (B.T.C.). Industrial Engineer, Walworth Manufacturing Company, Boston, Mass

Pradel, Alois Joseph, III, '00 (D). Designer, Killingly Worsted Company, Danielson, Conn.

Pradel, Mrs. Alois J. (Walker, Anna G.), IIIb, '03 (C). 534 South Main Street, Woonsocket, R. I.

Precourt, Joseph Octave, VI, '21 (B.T.E.). Section Hand, with Pacific Mills, Lawrence, Mass.

Prescott, Walker Flanders, IV, '09 (D). Manager, Prescott & Co., 234 Beaver Hall Hill, Montreal, Can.

Prince, Sylvanus Cushing, VI, '08 (D).

Proctor, Braman, IV, '08 (D). Salesman, Kuttroff, Pickhardt & Co., Inc., 86 Federal Street, Boston, Mass.

Putnam, George Ives, IV, '16 (B.T.D.). Chemist, McLoughlin Textile Corporation, Utica, N. Y.

Putnam, Leverett Nelson, IV, '10 (D). Overseer of Dyeing, Arlington Mills, Lawrence, Mass.

Putnam, Philip Clayton, IV, '13 (D). Foreman Dyer, Apponaug Finishing Company, Apponaug, R. I.

Quinlan, William Harold, VI, '20 (B.T.E.). Research Assistant, Warren Brothers Company, 32 Potter Street, Cambridge, Mass.

Radford, Garland, II, '20 (D). Manufacturer, Oriental Textile Mills, Houston, Tex.

Ramsdell, Theodore Ellis, I, '02 (D). Agent, Monument Mills, Housatonic, Mass.

Rasche, William August, III, '03 (D). Deceased.

Raymond, Charles Abel, IV, '07 (D). Assistant Superintendent, New England Fuel and Transportation Company, Everett, Mass.

Reed, Norman Bagnell, I, '10 (D). General Superintendent, Lawrence Manufacturing Company, Lowell, Mass.

Reynolds, Fred Bartlett, II, '08 (D). Purchasing Agent, M. T. Stevens & Sons Company, North Andover, Mass.

Reynolds, Isabel Halliday, III, '03 (C). Clerk, Pacific Mills Print Works, Lawrence, Mass.

Reynolds, Raymond, II, '24 (D).

Rice, Josiah Alfred, Jr., III, '20 (D). Assistant Manager and Buyer, Marshall Field & Co., Chicago, Ill.

Rich, Edward, IV, '15 (B.T.D.). President, Jackson Caldwell Company, East Boston, Mass.

Rich, Everett Blaine, III, '11 (D). Managing Director, Hotel Vendome, Boston, Mass.

Rich, Milton Scott, II '22 (D). With Riverina Mills, Medford Hillside, Mass.

Richardson, George Oliver, IV, '16 (B.T.D.). Color Chemist, National Aniline and Chemical Company, Inc., Shanghai, China.

Richardson, Richardson Perry, I, '13 (D). Salesman, H. F. Livermore Company, Boston, Mass.

Riggs, Homer Chase, VI, '17 (B.T.E.). Sales Engineer, Rodney Hunt Machine Company, Orange, Mass.

Ripley, George Keyes, II, '17 (D). Superintendent, Troy Blanket Mills, Troy, N. H.

Rivers, William Anthony, II, '24 (D). Night Superintendent, Nantanna Worsted Company, Northfield, Vt.

Roberson, Pat Howell, I, '05 (C). Merchant, James R. Roberson & Sons, Cropwell, Ala.

Roberts, Carrie Isabel, IIIb, '05 (C). Craft Work, 50 Mount Vernon Street, Lowell, Mass.

Robinson, Ernest Warren, IV, '08 (D). Superintendent, Belding Brothers & Co., Rockville, Conn.

Robinson, Russell, VI, '21 (B.T.E.). Assistant Textile Superintendent, American Cellulose and Chemical Manufacturing Company, Ltd., Cumberland, Md.

Robinson, William Carleton, III, '03 (C). With American Wool and Cotton Reporter, 530 Atlantic Avenue, Boston, Mass.

Robson, Frederick William Charles, IV, '10 (D).

Roche, Raymond Vincent, IV, '12 (D). With National Aniline and Chemical Company, Buffalo, N. Y.

Royal, Louis Merry, VI, '21 (B.T.E.). Principal, Wrangell High School, Wrangell, Alaska.

Rundlett, Arnold Dearborn, VI, '12 (D). Superintendent, Joseph Noone's Sons Company, Peterborough, N. H.

Russell, John William, IV, '20 (B.T.C.). Textile Chemist, United States Worsted Corporation, Lawrence, Mass.

Ryan, Lawrence Francis, IV, '23 (B.T.C.). Chemist, United States Color and Chemical Company, 93–95 Broad Street, Boston, Mass.

Ryan, Millard Kenneth Thomas, II, '24 (D). 165 East Central Street, Natick, Mass.

Sanborn, Frank Morrison, VI, '19 (B.T.E.). With Standard Towel Company, Newton, N. J.

Sanborn, Ralph Lyford, VI, '16 (B.T.E.). With Manville Jenckes Company, Loray Division, Gastonia, N. C.

Sargent, Walter Ambrose, I, '22 (D). Assistant Chief Examiner, Sidney Blumenthal & Co., Inc., Shelton, Conn.

Saunders, Harold Fairbairn, IV, '09 (D). Treasurer, Chemical Specialties Company, Cleveland, Ohio.

Savery, James Bryan, II '23 (D). Assistant Dyer, Berkshire Woolen Company, Pittsfield, Mass.

Sawyer, Joseph Warren IV, '15 (B.T.D.). Assistant Chemist, Franklin Mills, Franklin, N. H.

Schaetzel, André Paul, IV, '21 (B.T.C.). Chemist, Uhlig Piece Dye Works, Haledon, N. J.

Schwarz, Herman Louis, IV, '22 (B.T.C.). Salesman, Ciba Company, Inc., Providence, R. I.

Scott, Gordon Maxwell, IV, '20 (B.T.C.). Chemist, Holden-Leonard Company, Bennington, Vt.

Shaber, Hyman Jesse, VI, '17 (B.T.E.). With C. F. Hovey Company, Boston, Mass.

Shanahan, James Edward, II, '22 (D). With Stephen Sanford & Sons, Amsterdam, N. Y.

Shananquet, Mrs. Lee (Woodies, Ida A.), IIIb, '00 (C). 123 Earldon Avenue, S. E., Grand Rapids, Mich.

Shea, Francis James, II, '12 (D). Clerk, Corticelli Silk Company, Florence, Mass.

Sidebottom, Leon William, IV, '11 (D). Colorist, Essex Aniline Works, Inc., South Middleton, Mass.

Sjostrom, Carl Gustof Verner, Jr., III, '17 (D). Assistant Superintendent, Farnsworth Mills, Inc., Central Village, Conn.

Sleeper, Robert Reid, IV, '00 (D). Textile Chemist, Calco Chemical Company, Bound Brook, N. J.

Smith, Albert Adams, I, '99 (D). Deceased.

Smith, Doane White, II, '10 (D). General Superintendent, Chelsea Fibre Mills, 1155 Manhattan Avenue, Brooklyn, N. Y.

Smith, Frank Kenfield, II, '24 (D).

Smith, Herbert Jeffers, VI, '22 (B.T.E.). Overseer of Ring Spinning, Potter Fine Spinners, Inc., Pawtucket, R. I. . . . . .

Smith, Ralston Fox, I, '04 (C). Sales Manager, W. H. Warner & Co., Union Commerce National Bank Building, Cleveland, Ohio.

Smith, Stephen Eaton, I, '00 (D). Professor of Textiles; in charge of Cotton Yarn Department, Lowell Textile School, Lowell, Mass.

Smith, Theophilus Gilman, Jr., IV, '10 (D). Farming, Groton, Mass.

Snelling, Fred Newman, II, '03 (D). With the American Railway Express Company, Haverhill, Mass.

Sokolsky, Henry, VI, '17 (B.T.E.). Head of Time Study Department, B. F. Sturtevant Company, Hyde Park, Mass.

Southwick, Charles Hudson, IV, '22 (B.T.C.). With Glenlyon Dye Works, Phillipsdale, R. I.

Spiegel, Edward, II, '03 (C). Theatrical Business, New York City.

Standish, John Carver, IV, '11 (D). Superintendent, Albany Felt Company, Albany, N. Y.

Steele, Everette Vernon, IV, '24 (B.T.C.). Textile Chemist, Rohm & Haas Co., 40 North Front Street, Philadelphia, Pa.

Stevens, Dexter, I, '04, (D). General Manager, Esmond Mills, Esmond, R. I.

Stevens, Raymond Russell, IV, '19 (B.T.C.). Overseer of Dyeing, The Felters Company, Inc., Millbury, Mass.

Stevenson, Murray Reid, III, '03 (C). Farming, Princeton Depot, Mass.

Stewart, Arthur Andrew, II '00 (D). Professor of Textiles; in charge of Finishing Department, Lowell Textile School, Lowell, Mass.

Stewart, Walter Lawrence, III, '03 (D). In Real Estate Business, 257 West 100th Street, New York City

Stiegler, Harold Winfred, IV, '18 (B.T.C.). Instructor in Chemistry, Lowell Textile School, Lowell, Mass.

Stohn, Alexander Charles, III, '06 (C). Factory Superintendent, C. Stohn, Hyde Park, Mass.

Stone, Ira Aaron, IV, '09 (D). Cotton and Cotton Waste, Royal Manufacturing Company, 115 Federal Street, Boston, Mass.

Storer, Francis Everett, II, '07 (D). Cashier, Windham County National Bank, Danielson, Conn.

Stronach, Irving Nichols, IV, '10 (D). With Hampton Company, Easthampton, Mass.

Stursberg, Paul William, II, '07 (D). Died in 1913.

Sturtevant, Albert William, IV, '17 (D). Automobile Mechanic, Harry Pitts Ford Agency, 52 Hurd Street, Lowell, Mass.

Suhlke, Waldo Eric, IV, '20 (B.T.C.). 7 Banks Street, Waltham, Mass.

Sullivan, John David, VI, '12 (D). With Robert Gair Company, Bradford, Mass.

Sullivan, Lambert William, II, '23 (D).

Sullivan, Willard David, II, '23 (D). With Pacific Print Works, Lawrence, Mass.

Sunbury, Herbert Ellsworth, VI, '18 (B.T.E.). Assistant Superintendent, Multibestos Company, Walpole, Mass.

Sutton, Leslie Emans, I, '17 (D). Superintendent, Anniston Cordage Company, Anniston, Ala.

Swan, Guy Carleton, II, '06 (D). Chemist, in charge of Imports, United States Department of Agriculture, 641 Washington Street, New York City.

Sweeney, George Hamilton, II, '24 (D). 466 Putnam Avenue, Cambridge, Mass.

Sweet, Arthur Dutcher, VI, '21 (B.T.E.). 232 Parsons Street, Easton, Pa.

Swift, Edward Spooner, S. J., I, '02 (D). Clergyman, Church of the Immaculate Conception, Boston, Mass.

Sylvain, Charles Emile, VI, '13 (D). With International Machinery Company of 104 Pearl Street, New York City, at Rua Sao Bento, 30 Rio de Janeiro, Brazil.

Syme, James Francis, II, '00 (D). Vice-President and General Manager, Southern Worsted Corporation, Greenville, S. C.

Symmes, Dean Whiting, IV, '22 (B.T.C.). Chemist, National Aniline and Chemical Company, 113 High Street, Boston, Mass.

Thaxter, Joseph Blake, Jr., II, '12 (D). Salesman, Smith & Dove Manufacturing Company, Andover, Mass.

Thomas, Roland Vincent, I, '05 (C).

Thompson, Arthur Robert, Jr., IV, '22 (B.T.C.). Southern Representative, Rohm & Haas Company, Inc., 605 Johnston Building, Charlotte, N. C.

Thompson, Everett Leander, I, '05 (D). Salesman, Gulf Refining Company, Bradford, Mass.

Thompson, Henry James, IV, '00 (D). Dyer, United States Rubber Company, Malden, Mass.

Tilton, Elliott Thorp, II, '99 (D). Died January, 1917.

Todd, Walter Ernest, III, '23 (D). Assistant Designer, Chase Mills, Webster, Mass.

Toepler, Carl, IV, '22 (B.T.C.). Chemist, Pacific Mills, Lawrence, Mass.

Toovey, Sidney Ernest, II, '04 (C). Deceased.

Toshach, Reginald Alexander, II, '11 (D). Assistant Superintendent, M. T. Stevens & Sons Company (Pentucket Mills), Haverhill, Mass.

Toupin, Stephane Frederick, VI, '24 (B.T.E.). Engineering Department, Burson Knitting Company, Rockford, Ill.

True, William Clifford, II, '22 (D). Assistant to General Superintendent, Chelsea Fibre Mills, Brooklyn, N. Y.

Tyler, Lauriston Whitcombe, II, '16 (D). Salesman, W. T. Grant Company, 315–319 Summit Street, Toledo, Ohio.

Valentine, Burnet, VI, '23 (B.T.E.). With Crex Carpet Company, 295 Fifth Avenue, New York City.

Varnum, Arthur Clayton, II, '06 (D). Superintendent, Hamilton Woolen Company, Southbridge, Mass.

Villa, William Horace, VI, '24 (B.T.E.). Textile Engineer, Compania Colombiana de Tejidos, Medellin Colombia, S. A.

Walen, Ernest Dean, VI, '14 (B.T.E.). Assistant to the Agent, Pacific Mills, Lawrence, Mass.

Walker, Alfred Schuyler, II, '11 (D). 67 Park Avenue, Saranac Lake, N. Y.

Walker, Anna Gertrude, IIIb, '03 (C). See Pradel, Mrs. Alois J.

Walker, Raymond Scott, II, '23 (D). In Charge of Planning and Efficiency Department, Chelsea Fibre Company, Brooklyn, N. Y.

Wang, Chen, IV, '23 (B.T.C.). Student, Graduate School, Cornell University, Ithaca, N. Y.

Wang, Cho, VI, '23 (B.T.E.).

Wang, Tung Chuan, VI, '23 (B.T.E.).

Wang, Yung Chi, II, '21 (D).

Warren, Philip Hamilton, II, '05 (D). Superintendent, Hopeville Manufacturing Company, Worcester, Mass.

Washburn, John Milton, Jr., IV, '21 (B.T.C.). Salesman and Demonstrator, National Aniline and Chemical Company, Inc., 113 High Street, Boston, Mass.

Watson, William, III, '11 (D). Real Estate, Frank E. Watson, 25 Washington Square, Haverhill, Mass.

Webb, Frank Herbert, IV, '04 (D). Died March 20, 1919.

Webber, Arthur Hammond, IV, '01 (D). Chemist and Demonstrator, Melville Color Company, 93 High Street, Boston, Mass.

Webster, Joseph Albert, VI, '23 (B.T.E.). Overseer, Ludlow Manufacturing Associates, Ludlow, Mass.

Weinz, William Elliot, IV, '08 (D). Assistant to Manager. Grasselli Dyestuff Corporation, 908 Chestnut Street, Philadelphia, Pa.
Wells, Ai Edwin, VI, '20 (B.T.E.). Instructor, Electrical Engineering, Lowell Textile School, Lowell, Mass.
Wheaton, Walter Francis, VI, '23 (B.T.E.). Machinist. Curtis & Marble Machine Co., Worcester, Mass.
Wheelock, Stanley Herbert, II, '05 (D). Treasurer. Stanley Woolen Company, Uxbridge, Mass.
Whitcomb, Roscoe Myron, IV, '10 (D). Pharmacist, R. M. Whitcomb, Ashland, N. H.
White, Royal Phillip, II, '04 (D). Agent, Stirling Mills, Lowell, Mass.
Whitehill, Warren Hall, IV, '12 (D). Chemist, Brightwood Manufacturing Company, North Andover, Mass.
Wightman, William Henry, IV, '06 (D). Salesman, Ciba Company, Inc., 93 Broad Street, Boston, Mass.
Wilcox, Leonard Edward, VI, '24 (B.T.E.). Traveling Salesman, H. F. Livermore Company, Boston, Mass.
Williamson, Douglas Franklin, I, '22 (D). Assistant Superintendent, American Net and Twine Company. Blue Mountain, Ala.
Wilson, John Sigmund, II, '03 (D). Deceased.
Wilson, Walter Ernest Hudson, I, '04 (C). Deceased.
Wing, Charles True, '02 (D). Designer, Merrimack Woolen Corporation, Dracut, Mass.
Wingate, William Henry, IV, '08 (D). Superintendent of Dyeing, Franklin Process Company, Providence, R. I.
Wise, Paul Tower, II, '01 (D). Vice-President and General Manager, Chelsea Fiber Mills, 212 Fifth Avenue, New York City.
Woo, Tsunkwei, VI, '19 (B.T.E.). Head of Textile Department, Wah Chang Trading Corporation, Shanghai, China.
Wood, Ernest Hadley, S.B., IV, '11 (D).
Wood, Herbert Charles, I, '06 (D). Assistant Superintendent, Union Wadding Company, Pawtucket, R. I.
Wood, James Carleton, IV, '09 (D). Travelling Representative, R. T. Vanderbilt Company, New York City.
Wood, Lawrence Burnham, IV, '17 (B.T.C.). Divisional Superintendent Sayles Finishing Plants, Inc., Phillipsdale, R. I.
Woodcock, Eugene Close, II, '07 (D). Agent, Chelsea Fiber Mills, 1155 Manhattan Avenue, Brooklyn, N. Y.
Woodies, Ida Alberta, IIIb, '00 (C). See Shananquet, Mrs. Lee.
Woodhead, Joseph Arthur, VI, '23 (B.T.E.). With Pacific Print Works, South Lawrence, Mass.
Woodman, Harry Lincoln, I, '02 (C). Engineer, Cotton Engineering Department, Saco-Lowell Shops, Lowell, Mass.
Woodruff, Charles Beauregard, I. '06 (C). Secretary and Buyer, United Factories Company, Inc., Birmingham, Ala.
Worthen, Clifford Tasker, IV, '22 (B.T.C.). Textile Chemist, Sayles Finishing Plants, Saylesville, R. I.
Wotkowicz, Michael Joseph, VI, '20 (B.T.E.). With Berkshire Cotton Manufacturing Company, Adams, Mass.
Wright, Edward, II, '05 (C). Assistant Engineer, State Department of Health, 141 State House, Boston, Mass.

Yavner, Harry, II, '12 (D). With Mayo's Hardware Company, Jamaica Plain, Mass.

Zisman, Louis Samuel, IV, '20 (B.T.C.). Chemist, Head of Dyeing Department, Gotham Silk Hosiery Company, Inc., 401 East 33d Street, New York City.

SERIES 28. No. 4 May, 1925

BULLETIN

OF THE

Lowell Textile School

LOWELL, MASS.

Issued Quarterly

1925.

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STUDY OF RELATION OF YARN STRENGTH TO FIBER STRENGTH IN A 23-5-3 CORD.

Introduction

This paper presents an abstract from two studies made for the purpose of determining the ratio which exists between the strength of cotton fibers and the strength of a yarn made from them. One study was made by Mr. Leonard Wilcox in 1924 and the other by Mr. Clarence A. Anderson in 1925.

Both men used the same type of yarn, namely a 23-5-3 tire cord made from combed Egyptian Cotton, for the reason that it is a highly standardized type of cord and one that in every way shows exceptional uniformity.

Theory

The theory underlying these studies is that the theoretical breaking strength of a yarn may be determined by finding the average number of fibers in a cross-section of the yarn and multiplying this by the average breaking strength of the individual fibers. By comparing the actual breaking strength of the yarn with this theoretical breaking strength we are able to learn the extent to which we actually fail to realize the strength of the fibre in the yarn.

It goes without saying that the extent to which we realize the strength of the fibers in a yarn is always a variable quantity, as factors other than fibre strength enter into the problem.

The twist in the yarn, the mechanical arrangement of fibers in the strand, the extent to which short and weak fibers have been removed are some of the factors which contribute to the variations in this problem.

Procedure

The manner of carrying out these studies was identical and included the following tasks:—

(1) Determination of strength of 23-5-3.
(2) Determination of strength of single fibers.
(3) Determination of number of fibers in a cross-section.
(4) Determination of the dimensions of fibers.

Yarn Strength

The strength of the finished cord was determined by making forty determinations. A single strand testing machine using a length of five hundred millimeters of yarn and having a travelling jaw moving at twelve inches per minute was used. These tests were made in an atmosphere of 65% relative humidity at about 72 degrees Fahrenheit.

Fiber Strength

Fibers were secured by untwisting the yarns and removing therefrom material for determining the strength of individual fibers. Each fiber was mounted on a perforated strip of paper for testing. After clamping the paper and fiber in the jaws of the testing machine the paper was cut apart leaving the fiber free for testing.

Fiber testing is one of the most difficult tasks in connection with such a study on account of the extreme fineness of the fiber as well as its delicacy. Two hundred single fibers were broken in this portion of the investigation.

Fibers in a Cross-Section

To determine the number of fibers in a cross-section the finished cord was cut into lengths of one-half inch taken at random. These half-inch lengths of cord were then untwisted and the single yarns untwisted so that the number of fibers could be counted. Two short fibers were counted as one in

fixing the number of fibers in a cross-section. Four hundred fifty specimens of the single twenty-three yarn were examined in this manner.

Fiber Dimensions

A study of the dimensions of the individual fibers was made in 1925 to see if any light might be thrown upon the problem, and in order that future experiments along this line might have a known fiber dimension for comparison. This work was done with a Spencer microscope fitted with an ocular micrometer which was calibrated by comparison with a standard stage micrometer.

Two hundred readings of fiber diameter were made taking some care that small and large dimensions were read in equal numbers.

The following tabulation illustrates some of the more important points brought out by these investigations.

Tabulation

Type of yarn used C. Eg. Tire Cord	23-5-3
Average strength of 23-5-3 in kg.	7.415
Average strength of single fibers in grams	5.822
Average number fibers in a cross-section of single 23's	149
Average number of fibers in a cross-section of 23-5-3	2238
Average diameter of single fibers in millimeters	.0157
Proportion of fiber strength realized in 23-5-3	57%

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BULLETIN

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CALENDAR.

1925.

October 1, Thursday	Registration.
October 8, Thursday	Registration.
October 13, Tuesday	Opening of evening school.
November 26, Thursday November 27, Friday	Thanksgiving recess. No classes.
December 22, Tuesday	End of first term.

1926.

January 4, Monday	Opening of second term.
March 12, Friday	Closing of evening school.
April 7, Wednesday	Graduation.

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EDITH CLARA MERCHANT . . . . Evening Instructor in Freehand Drawing.	. 268 Westford Street.
FORREST ALBERT MILLS . . . . Evening Instructor in Machine Shop.	. North Billerica.
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CARLYLE DARRACOTT FISKE, S.B. . . . . . Evening Instructor in Worsted Yarns.	40 Lawrence Street, Lawrence.

THE LOWELL TEXTILE SCHOOL.
EVENING CLASSES.
GENERAL INFORMATION.
Entrance Requirements.

All applicants to the evening classes must understand the English language and simple arithmetic. Those who are graduates of a grammar or high school are admitted upon certificate. Those who cannot present such a certificate are required to take examination in the subjects of English and arithmetic. In the examination in English a short composition must be written on a given theme, and a certain amount must be written from dictation. In the examination in arithmetic the applicant must show suitable proficiency in addition, subtraction, multiplication, division, common and decimal fractions, percentage, ratio and proportion. Opportunity to register or to take these examinations is offered each year, generally on the Thursday evenings of the two weeks previous to the opening of the evening school.

Registration.

Before entering the class a student must fill out an attendance card, which can be obtained at the office or from the instructors in the various departments.

Any student who has filed an attendance card and who wishes to change his course must notify the office before making the change.

Sessions.

The evening classes commence the second Monday of October and continue for twenty-one weeks. The school is open on four evenings each week during the period mentioned, except when the school is closed for holiday recesses.

Supplies.

Students must provide their own books, stationery, tools, etc., and pay for any breakage or damage that they cause.

Student's supplies will be sold from the storeroom every evening school night from 6.45 to 7.15 P.M.

Fees and Deposits.

All evening courses are free to residents of Lowell. To those outside of Lowell the fee is $10 per year for *each course of two nights per week.* Students taking two courses or attending courses requiring more than two nights per week are required to pay $15 per year for three nights and $20 for four nights.

All fees and deposits must be paid in advance.

All students, whether from Lowell or not, taking Course (*a*), Chemistry and Dyeing Department, are required to make a deposit at the commencement of the course, — $5 for first-year students, and $10 for second-year students. A deposit of $10 will be required of all students taking Course (*b*), (*c*) or (*d*). This is to cover the cost of laboratory breakages, chemicals, apparatus, etc., and at the end of the year any unexpended balance is returned, or an extra charge made for the excess breakage.

Every student who takes the chemistry and dyeing course must check up his desk with the instructor of that department when he leaves the school. Any student not doing so will be charged 50 cents.

All students taking Machine-shop Practice will be required to make a deposit of $5. Any unexpended balance remaining at the end of the year will be returned to the student.

Report of Standing.

A report of standing covering the year's work is sent to all students who attend the entire year and take the necessary examinations.

Certificates.

The courses of the evening school are varied and arranged to meet the special needs of those engaged in the industry. They vary in length from one to four years, and at the completion of each course the certificate of the school is awarded, provided, however, that the student has been in attendance in the course during the year for which the certificate is granted.

GENERAL EVENING COURSES.

The Lowell Textile School now offers to students several general courses. For each course a definite schedule is arranged which requires attendance of from six to eight hours per week.

The object of these courses is to give young men of ambition an opportunity to obtain instruction in all the branches of science that are allied with their daily work. For example, one who is employed as a weaver in a textile mill may, by means of the courses in manufacturing, obtain knowledge of the manufacture of yarn, the production of a design, and the methods of finishing a fabric, as well as the manner of its weaving or knitting. In like manner the dyer may augment his knowledge of the chemicals and materials he is daily handling. The engineer and machinist may acquire a knowledge of the mathematics, science of mechanics, electricity and drawing that underlie all the work of an engineer.

It is recognized that the interests of such students lie in a particular field of industry, and these courses are designed to bear directly upon the special line, and supplement, as far as possible, the practical work in which the student is engaged during the day.

The student selects his course upon entrance, and continues a regular schedule of subjects for three, four or five years, as may be necessary for its completion.

In a word, any man having a common school education and the ambition to advance in his line may now secure a broad and comprehensive training in the subjects which will be of vital importance to him in obtaining the goal of his ideal.

These general courses are supplemented by partial courses in all the subjects given, so that a student who finds it impracticable to carry on all the subjects in a complete course may select and take such subjects as will be of most value to him in his work.

A student taking one of these courses may attend school during the periods in which the subjects which he selects are being given.

A description of all courses follows.

COTTON DEPARTMENT.

I. Cotton Manufacturing — 4 Years.

The Cotton Manufacturing course is designed to give a student a broad knowledge of the manufacture of cotton cloth. To do this he is required to spend three years in the department of cotton yarns, studying cotton and its conversion into yarn. A student taking this course also spends two years in weaving, one on plain and one on dobby weaving. Three years are spent in a study of the art of designing a fabric and the analysis of fabric already constructed. One year is spent in a study of the processes involved in finishing cotton fabrics. For detailed description, see subjects under Yarns, Weaving, Designing and Finishing.

Ia. Cotton Yarns — 3 Years.

The first year's work in cotton yarn manufacture consists of a study of cotton and its preparation for market, followed by a study of picking, carding and combing.

The work in the picking, carding and combing classes consists of lectures on these operations combined with problems that are peculiar to each operation such as the drafts used and the production of each process as well as the amounts of waste made. Special consideration is given to the adjustment and care of these machines and some laboratory demonstration is used to show the manner of adjusting machines for the purpose of controlling the weight of the product, the amount of work done in a day and the control of waste.

The second year's work includes a study of the drawing and roving processes and the calculations that accompany these operations. It consists also of lectures on the machines and demonstration of their adjustment, showing roll setting, draft and twist control, builder adjustment, spacing coils on the bobbin, and tension control.

During the third year the time is devoted to a study of ring and mule spinning and twisting, and as in previous years, the work consists of lectures and demonstration on the machines. During this year there is also some work done on the combing machine, particularly in the nature of its adjustment. In addition to these subjects, there is some work done in the way of planning the organization

of a cotton mill with a view to showing drafts, speeds, productions and number of machines of each kind necessary for the production of a given amount of a certain yarn.

II. Wool Manufacturing — 4 Years.

In the branch of yarn manufacture the student must elect either worsted yarns or woolen yarns. In other respects the course is the same.

During the first year, courses are given in wool fibers and the preliminary processes of their conversion into yarns, calculations of the mechanism of the machines and elementary instruction in cloth designing and analysis.

During the second year, students selecting the woolen yarn option follow a course in carding and mule spinning and continue the first-year work in design and cloth analysis. Those selecting the worsted yarn option do likewise, excepting that their course in yarn instruction is on the worsted systems.

In the third year, students of the woolen yarn option finish their instruction in yarn manufacture and add to the course of design and cloth analysis a course in weaving. Students of the worsted yarn option add the same course in weaving and continue the second-year courses of worsted yarn and designing and cloth analysis.

The fourth-year courses consist of weaving and finishing.

This course is arranged to give those engaged in the manufacture of woolens and worsteds instruction in the various branches of the work. It embraces a study of wools and allied fibers and the manner of manipulating from fibers to finished fabric, including all the processes of yarn manufacturing, weaving, designing and finishing.

For detailed description of subjects see page 9.

IIa. Woolen Yarns — 2 Years.

This course is offered for students who wish instruction in woolen yarn manufacture and consists of a lecture course during the first year on the various kinds of wool fibers, trade terms, sorting, scouring, carbonizing, etc., also of a course on carding. The second year continues the instruction on carding and then takes up a course on the mule and woolen yarn spinning.

IIb. Worsted Yarns — 2 Years.

For those who desire instruction in the manufacture of worsted yarns this course is offered. The first-year work consists of a lecture course on the various kinds of wool fibers, trade terms, sorting, scouring, carbonizing, etc., also a course in carding and the calculations involved in the mechanism of the machines, and a course covering gilling and combing and the processes of top making. The second year is devoted to detail study of the English and French systems of worsted yarn manufacture.

For detailed description of subjects see page 9.

DESIGN DEPARTMENT.

IIIa. Cotton Design — 3 Years.

For those who wish to devote intensive study to the designing of cotton fabrics this course of designing and cloth analysis is offered. Instruction is given in the design and analysis of the standard fabrics and as many of the fancy designs and weaves as the time will permit.

IIIb. Woolen and Worsted Design — 3 Years.

This course covers the design and analysis of standard woolen and worsted fabrics and is intended for those who wish to specialize in this branch of textile fabric manufacture. Special and fancy fabrics are studied to the extent that time will permit.

For detailed description of subjects see page 10.

Va. Cotton Weaving — 1 Year.

Vb. Woolen and Worsted Weaving — 2 Years.

Vc. Dobby and Jacquard Weaving — 1 Year.

These are called weaving courses, but in reality they might more properly be called courses in loom fixing, for particular attention is given to the mechanism of

the looms, the timing of the various parts, and the adjustments possible to produce desired results. Here, again, is an opportunity for students to fix, dismantle, erect and adjust looms in a way that could not be tolerated in any mill. Frequently students come to the classes with the knowledge that certain adjustments must be made upon a loom if certain results are to be obtained, but the reason for these is not known. The school offers the machine, time and instructor in order that the weaver or loomfixer may determine for himself the reason for some rule which he practices in his daily work. Not only can he become more familiar with the loom upon which he works every day, but he can study the operations of many other makes of looms.

For detailed description of subjects see page 12.

IIIc. Freehand Drawing — 3 Years.

In the course in freehand drawing, instruction is given in the drawing from models, casts and designs. Work is taken up in charcoal and also in colors. This course has appealed to many young women of the city, and it is believed that this is a most fortunate opportunity for both young women and young men of Lowell to acquire the elements of artistic designing.

CHEMISTRY AND DYEING DEPARTMENT.

Hardly any branch of applied science plays so important a part in our industrial world as chemistry. Many large mills employ the chemist as well as the dyer, and with the great progress which is being made in the manufacture and application of dyestuffs, a basic knowledge of chemistry becomes an absolute necessity to the dyer. Within a comparatively short distance from Lowell are establishments employing men who require some knowledge of chemistry but who may not necessarily use dyes. Some find a knowledge of analytical chemistry helpful in their everyday work.

To meet these varying needs of our industrial community, the school offers a two-year course in general chemistry, organic and inorganic, which may be followed by any one of three courses, viz., textile chemistry and dyeing, analytical chemistry, and textile and analytical chemistry. In order to take Courses IVb, IVc or IVd, candidates must have a certificate from Course IVa, or show by examination or approved credentials that they have taken the equivalent of the work covered by this course.

For detailed description of subjects see page 12.

IVa. Elementary Chemistry — 2 Years.

General Chemistry, including Inorganic and Organic.

Qualitative Analysis.

One lecture and one Laboratory Period per week in General Chemistry the first year, continued three nights a week during the second year, when the Elementary Organic Chemistry and Qualitative Analysis is completed.

IVb. Textile Chemistry and Dyeing — 3 Years.

Lectures in Textile Chemistry and Dyeing.

Laboratory Work in Dyeing.

Covered by 40 lectures and two nights of laboratory work per week.

IVc. Analytical Chemistry — 3 Years.

Laboratory Work and Lectures in Quantitative Analysis.

Three nights per week of class-room and laboratory work.

IVd. Textile and Analytical Chemistry — 4 Years.

Lectures in Textile Chemistry and Dyeing.

Laboratory Work in Analytical Chemistry.

Combines all lectures in Textile Chemistry and Dyeing with work of Course IVc, but does not include any Dyeing Laboratory. Three nights per week.

TEXTILE ENGINEERING DEPARTMENT.

VIa. Engineering Course — 3 Years.

This course has been arranged with the object of offering to those engaged in the mechanical and electrical departments of our mills opportunities to learn something concerning the theory underlying the many practical methods which they pursue during the day.

The course in the first year is laid out to include the fundamental subjects upon which all engineering rests, — mathematics, mechanics and mechanism of machines, and mechanical drawing. This elementary work is then strengthened by an additional year of mathematics and by two more years of drawing. Strength of materials is included in the second year, while the major portion of the third year's work is devoted to a consideration of the elements of steam and electrical engineering.

For detailed description of subjects see page 14.

VIb. Mechanical Drawing Course — 3 Years.

For one having occasion to make a sketch or detail drawing for the purposes of illustration or instruction, or for one who is daily required to work from a drawing or blue print, the course in mechanical drawing is offered. It first lays a foundation of the principles of mechanical drawing, and follows this with two years' work in drawing directly from parts of machines, preparing both the detail and the assembly drawing.

For detailed description of subject see page 14.

VId. Machine Shop Course — 3 Years.

The first year of this course is spent upon subjects which will prepare the student to more readily assimilate and appreciate the real work in the shop itself. Hence a large part of the first year's work is devoted to the mechanics and mechanism of machines, so that the student will be familiar with the principles used in transmitting force and motion in the machine tools upon which he spends most of his time during his second and third years. Since the ability to read and interpret a drawing is an elementary requirement of every machinist, it is required that a portion of each of the three years be devoted to that subject.

Thus it becomes possible for one who may be working at the bench during the day to learn how to operate a lathe or other tool, or for a lathe hand to acquire a knowledge of a planer, shaper, milling machine, grinder, etc. A man who has a knowledge of the special machine which he operates may by means of this course become a more intelligent machinist. He should supplement this course with the courses in mechanical drawing and mechanism, in order that his training for an all-round machinist or mechanic may be more complete.

For detailed description of subjects see page 14.

VIe. Electrical Engineering Course — 3 Years.

This course is planned to cover the fundamentals of both direct and alternating current electricity. It requires for its completion three years, three evenings per week, and the student enrolling in this course must be prepared to spend from four to six hours per week in home study and preparation. The lectures on electrical theory are supplemented by laboratory work, and the electrical drawing is intended to familiarize the student with electrical wiring and diagrams. In order to be admitted to this course the student must have completed the amount of mathematics described under Mathematics — First Year, on Page 15.

VIf. Direct Current Electricity — 2 Years.

The work of this course comprises the first two years of Course VIe for the satisfactory completion of which a certificate will be awarded.

FINISHING DEPARTMENT.

VIIa. Cotton Finishing — 1 Year.

VIIb. Woolen and Worsted Finishing — 1 Year.

In these courses machine work is supplemented by lectures and discussions pertaining to the many finishes given to fabrics. The action of soaps, water, steam, heat and cold upon cloth containing one fiber or combinations of fibers as used in commercial fabrics is carefully studied. These courses also help the finisher to broaden his knowledge of textile fabrics.

For detailed description of subjects see page 15.

SUBJECTS OF INSTRUCTION.

COTTON DEPARTMENT.

Cotton Yarns.

Instruction is given by means of lecture and demonstration. The outline of the course is as follows: —

Fiber. — Before taking up the details of the operation of manipulating the fiber into yarn, a careful study is made of the characteristics and classification, both botanically and commercially, of the many varieties of the cotton fiber. Methods employed in cultivating, marketing, grading and stapling are considered, and under these heads a detailed study is made of the types of gin employed.

Opening and Picking. — Instruction in the preliminary operation of opening and picking covers the mechanical construction of the machines, their parts and adjustments, as fully as the manufacturing results accomplished by the machines. This includes such construction details as evener, lap measuring and safety stop motion, grids, cleaning trunks, beaters, etc.; also operation details which involve the adjustment of waste, drafts and character of laps.

Carding. — The process of carding is considered one of the most important, and proper time is devoted to the construction and operation of cards that the student may be familiar with the various parts of the card and the function and design of each. The construction and application of card clothing, as well as the methods of grinding, form a part of the work.

Drawing. — Under this head is taken up the theory of doublings and their effect upon the quality of roving and yarn. Like previous and subsequent processes the machine construction forms an important part of the work. Proper stress is paid to such subjects as stop motions, drawing rolls and their covering, cleaners and evener motions.

Roving Processes. — Under this head are studied the various machines known as the slubber, intermediate, fine and jack fly frames. The relative motion of the various parts of these machines is so complex that a good opportunity is here presented to fix in the student's mind the application of certain mechanical principles that are used in other departments and upon other machines in the manufacture of textile material. With each process of yarn manufacture are explained the systems of sizing and numbering, and under this head are taken up both the metric and English systems.

Ring Spinning and Twisting. — The consideration of spinning yarn by the ring frame method involves a knowledge of the uses to which the yarn is to be put, subsequent methods of handling that proper roving may be selected, suitable amounts of draft and twist provided, correct size of rings and travelers selected, building motions suitably adjusted, etc. The operation of twisting yarns is so closely related to spinning by the ring method that it is studied at the same time. This opens an almost limitless field of novelty yarn manufacture, and offers a very good opportunity to derive new types of yarn or new mechanism to produce the effects. Yarn defects are studied with reference to the cause and remedy.

Mule Spinning. — This method of spinning is very different from that of the ring frame, and the mechanical details are more complicated. The student is furnished with new means of producing yarns, and can compare the relative advantage of each method. A thorough understanding of mule spinning is perhaps more a study of mechanical motions and their functions. This results almost invariably in assisting the student to understand previous processes and machines better because of his work on the mule. It is the object to make clear to the student's mind the principles underlying the construction and operation of the parts that control the drawing, twisting, backing off, winding, together with such special motions and devices as are used upon the modern mule.

Combing. — This process is explained by lecture work and by operation and assembling of the various types of combs in service in the laboratory. The object of combing is fully considered, and the different means employed on the many types of combers on the market are studied. This includes such types as the Heilman, New Whitin and Nasmith combers.

WOOLEN AND WORSTED DEPARTMENT.

Woolen and Worsted Yarns.

Raw Materials. — A study of raw materials which enter into the manufacture of woolen or worsted yarns, or are made into yarns by processes similar to those employed in the manufacture of woolen and worsted yarns, would include silk, mohair, alpaca, vicuna, cashmere, camel's hair and cotton. In connection with these are considered shoddy, noils and extracts.

Wool Sorting. — Familiarity with the various grades and kinds of wool is obtained by lecture. The various characteristics and properties are explained, as are also trade terms, such as picklock, XXX, XX, ½-blood, ⅜-blood, ¼-blood, delaine, braid, etc. Some skill is acquired in the estimation of shrinkage and in judging the spinning qualities.

Wool Scouring. — The object of scouring and the methods employed are explained, and this involves the consideration of the soaps and chemicals used in washing; also the waste products and their utilization. Actual work is done in scouring a commercial quantity of wool by machines that are made similar in operation to regular commercial machines. A study is made of the effect of the hardness of water upon soap. At the same time the use of driers, their operation and regulation, is taken up, and the methods of carbonizing wool, noils, burr waste, rags, etc., are studied and explained.

Burr Picking, Mixing, Oils and Emulsions. — The use of burr pickers in cleaning wool and the use of mixing pickers in making color blends is covered by lecture and demonstration. Under the subject of oil and emulsions are taken up the characteristics of various oils and the means employed to test them.

This work is taken only by those students who are pursuing the Woolen Manufacturing Course.

Carding. — The different systems of carding wool, depending on whether it is to be made into woolen or worsted yarns, are fully explained, as is also the construction, setting and operation of cards. A part of this work consists of a study of card clothing, its construction, application and grinding.

Woolen Mule. — The student studies thoroughly the operation of the mule as a whole, and acquaints himself with the various principal mechanisms, as, for example, the backing off and winding motions, the quadrant, builder-rail, faller regulation, etc.

Top Making and Combing. — This branch takes up, besides the carding of the wool on a worsted card, the preparing processes, backwashing, also gilling of the stock before and after combing. The construction of the gill boxes and combs is studied by lectures. Later, quantities of stock are made into top and then into yarn.

The Noble, Lister and French combs are studied, and the various calculations to determine draft, noiling, productions, etc., are made.

Drawing and Spinning. — The equipment in the laboratory offers opportunity to make worsted yarn by either the Bradford or open drawing system or by the French system. The process includes the various machines in the successive steps of making Bradford spun yarn, and the functions of the different machines are studied. In the latter, or French system, the stock is run through the drawing machines, and the roving spun into yarn on the worsted mule. The same method of studying the mechanism and operations of these machines is followed as in the case of previous methods of instruction. The student by pursuing this course can compare the different methods of yarn manufacture and note the results of each.

With the instruction in spinning by the Bradford system is given work on the twisters and the effects that may be produced.

TEXTILE DESIGN AND WEAVING DEPARTMENT.

Textile Design.

During the first year instruction is given in the subject of classification of fabrics, use of point or design paper, plain fabrics, intersection, twills and their derivation, sateen, basket and rib weaves, checks and stripes, fancy weaves, including figured and colored effects; producing chain and draw from design, and *vice versa;* extending and extracting weaves.

For Cotton Goods.

During the second year consideration is given to fancy and reverse twills, diaper work, damasks, skip weaves, sateen fabrics with plain ground, backed fabrics, and multiple ply fabrics. Students are required to make original designs. Special attention is given to the consideration of color effects.

The analysis of these fabrics forms a part of the course in design. This also includes the necessary calculations required to reproduce the fabric or to construct fabrics of similar character.

For Woolen and Worsted Goods.

During the second year the instruction given includes warp and filling backed cloth, figured effects produced by extra warp and filling, double cloths, multiple ply fabrics, cotton warps, blankets, bath robes, crêpes, filling reversible, Bedford cords, imitation furs, crêpons, matelasse and imitations, double plain, ingrains, velvets, corduroys, overcoatings, trouserings.

The analysis of these fabrics, together with the consideration of the shrinkages and dead loss in all fabrics, theory of diameter of yarns, and costs of mixer blends, is a part of this course.

The advanced work takes up the more complicated weaves adapted to harness work, and leads into leno and Jacquard designs. The following is a brief list of the subject heads, which will give some idea of the course: double plain cloths, ingrains, tricots, chinchilla, tapestry, blankets, upholsteries, spot weaves, pile or plush, crêpon, matelasse and its imitations, piqué, marseilles, quilting and miscellaneous designs for Jacquard, leno, fustian, tissue fabrics and lappets.

Cloth Analysis.

In the first year this subject takes up in a systematic manner the analysis of samples illustrating the various cloth constructions for the purpose of determining the design of the weave and the amount and kind of yarns used, and forms the basis of calculation in the cost of reproducing any style of goods. The various topics discussed are reeds and setts; relation and determination of counts of cotton, woolen, worsted, silk and yarns made from the great variety of vegetable fibers; grading of yarns, folded, ply, novelty and fancy yarns; application of the metric system to yarn calculation; problems involving take-up, average counts, determination of counts of yarn, and weight of yarn required to produce a given fabric.

Cloth Construction.

The work includes the application of the different weaves and their combinations in the productions of fancy designs, both modified and original; the calculation involved in the reproduction of standard fabrics changed to meet varying conditions of weight, stock, counts of yarn and value.

Instruction in this subject, which is given by classroom work, is intended to bring together the principles considered under the subject of design, cloth construction, weaving and yarn making of previous years, and to show the bearing each has in the successful construction of a fabric.

Power Weaving.

Instruction in cotton weaving is carried on upon power looms in connection with the work in Textile Design and Cloth Analysis. This includes a study of the preparation of warps, beaming, dressing, sizing, drawing-in and making of chains, the cutting and lacing of cards, spooling and quilling and the machinery for the same. A study is made of warpers and sizing machines, both for cotton and woolen. Lectures are given to correspond with the progress of the student in the Power Weaving Laboratory covering the following subjects: loom adjustments, chain building, shuttle changing looms, dobby looms, single and double acting dobbies, handkerchief motions, leno weaving, center selvedge motions, filling changing looms, oscillating reeds, lappet motions, various shaker motions, towel and other pile cloth weaving, Jacquard looms, single and double lift leno Jacquards, Jacquards of special design, tying up Jacquard harness. Instruction is also given in weaving on fancy woolen and worsted looms.

Cotton Weaving.

The course in Cotton Weaving covers instruction on plain looms, Draper Automatic looms, and also on the Stafford Automatic looms. It includes instruction on the construction of shedding and picking motions, take-up and let-off motions together with the operation of the magazines and hoppers and methods of changing shuttle and bobbin. Instruction is also given on the Crompton and Knowles Automatic Towel Looms and the various types of box looms, including chain building and work on multipliers.

Woolen and Worsted Weaving.

This course includes instruction on the Crompton and Knowles loom and takes up general construction, head motions, take-up, let-off, filling stop motion, etc. The course also includes warp preparation.

Dobby and Jacquard Weaving.

This course considers the various types of Jacquard heads and dobbies, which includes single cross border dobbies and leno attachments on double lift dobbies. The course on Jacquard looms includes general construction and card cutting, lacing, repeating, and fixing.

CHEMISTRY AND DYEING DEPARTMENT.

General Elementary Chemistry (Inorganic and Organic Chemistry).

Instruction in Elementary Chemistry extends through two years, and includes lectures, recitations and a large amount of individual laboratory work upon the following subjects: —

Theoretical Chemistry. — Chemical action, chemical combination, combining weights, atomic weights, chemical equations, acids, bases, salts, Avogadro's law, molecular weights, formula, valence, periodic law, etc.

Non-metallic Elements. — Study of their occurrence, properties, preparations, chemical compounds, etc.

Metallic Elements. — Study of their occurrence, properties, metallurgy, chemical compounds, etc.

The students take up, as thoroughly as time will permit, the qualitative detection of the more common metals and non-metals, with practical work.

This work, although necessarily elementary, is intended to prepare the student to more understandingly study the manufacture of dyestuffs and coal tar colors in the more advanced courses which follow.

Qualitative Analysis.

The laboratory work during the second year of the Elementary Chemistry course consists entirely of Qualitative Analysis. While this course is necessarily taken up in an abbreviated and elementary manner, it is so arranged that the students may become familiar with the separations and the detections of the common metals and acids. This course is also preliminary to the work given in Analytical Chemistry.

During the first year of the Elementary Chemistry course most of the time will be devoted to the non-metals and theoretical chemistry, and the laboratory work will be briefly upon the non-metals.

During the second year the classroom work will be upon metals and the hydrocarbons and their derivatives, and the laboratory work will be qualitative analysis.

Textile Chemistry and Dyeing.

The outline of the lecture course given in Textile Chemistry and Dyeing is as follows: —

Technology of Vegetable Fibers. — Cotton, linen, jute, hemp, china grass. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Animal Fibers. — Wool, mohair, silk. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Artificial Fibers. — Study of the various forms of artificial silk, the process of manufacture, their properties and action with chemicals, acids and heat.

Operations preliminary to dyeing. — Bleaching of cotton and linen; wool-scouring; bleaching, fulling and felting of wool; carbonizing; silk-scouring and bleaching; action of soap.

The bleaching of cotton is studied with description of the various forms of kiers and machinery used; also the action of the chemicals used upon the material, and the various precautions that must be taken in order to insure successful work.

Under this heading is included a study of the reagents used in the emulsive wool-scouring process, and their action upon the fiber under various conditions; also the most successful of the solvent methods for degreasing wool.

Water and its Application in the Textile Industry. — Impurities present methods for detection, their effect during the different operations of bleaching, scouring, dyeing and printing, and the methods used for their removal or correction.

The important subject of boiler waters is also studied under this heading, with a full discussion of the formation of boiler scale, its disastrous results, and the methods by which it may be prevented.

Mordants and Other Chemical Compounds used in Textile Coloring, and classified as Dyestuffs. — Theory of mordants, their chemical properties and application, aluminum mordants, iron mordants, tin mordants, chromium mordants, organic mordants, tannin materials, soluble oil, fixing agents, leveling agents, assistants, and numerous other compounds not dyestuffs that are extensively used in the textile industry.

Under this heading are included the definitions of various terms and classes of compounds used by textile colorists, such as color lakes, pigments, fixing agents, developing agents, mordanting principles and leveling agents.

Natural Organic Coloring Matters. — Properties and application of indigo, logwood, catechu or cutch, Brazil wood, cochineal, fustic, turmeric, madder, quercitron bark, Persian berries, and other natural dyestuffs that have been used in recent years by textile colorists.

Mineral Coloring Matters. — Under this heading are discussed the properties of such inorganic coloring matters and pigments as chrome yellow, orange and green, Prussian blue, manganese brown, iron buff.

Artificial Coloring Matters. — General discussion of their history, nature, source, methods of manufacture, methods of classification and their application to all fibers.

Special study of basic coloring matters, phthalic anhydride colors, including the eosins and phloxines; acid dyestuffs, Janus, direct cotton, sulphur and mordant colors, including the alizarines and other artificial coloring matter requiring metallic mordants; mordant acid and insoluble azo colors, developed on the fiber; reduction vat colors, aniline black and other artificial dyestuffs not coming under the above heads.

As each class of dyestuffs is taken up the details of the methods of applying them upon all the different classes of fabrics and in all the different forms of dyeing machines are thoroughly discussed; also the difficulties which may arise in their application, and the methods adopted for overcoming them.

Machinery used in Dyeing. — A certain amount of time is devoted to the description of the machinery used in the various processes of textile coloring, which is supplemented as far as possible by the use of charts, diagrams and lantern slides.

During the third year of this course, if time permits, the more advanced subjects of union dyeing, textile printing, dye testing, color matching and color combining will be briefly considered.

Dyeing Laboratory.

Besides lectures and recitations upon the subject of Textile Chemistry and Dyeing, practical laboratory work is required. By the performance of careful and systematic experiments the student learns the nature of the various dyestuffs and mordants, their coloring properties, their action under various circumstances, and the conditions under which they give the best results. The more representative dyestuffs of each class are applied to cotton, wool and silk, and each student is obliged to enter, in an especially arranged sample book, a specimen of each of his dye trials with full particulars as to the conditions of experiment, percentage of compounds used, time, temperature of dye bath, etc.

For convenience and economy most of the dye trials are made upon small skeins or swatches of the required materials, but from time to time students are required to dye larger quantities in the full-sized dyeing machines.

Analytical Chemistry.

The object of this course will be to give the student a general idea of the underlying principles of Analytical Chemistry, with a sufficient amount of laboratory work to enable him to become proficient in performing the ordinary routine analysis

of the textile plant. Frequent recitations will be held for the discussion of methods and the solution of stoichiometrical problems.

The work covered the first two years is based on Smith's "Quantitative Analysis," and for the advanced work, consisting of the analysis of soap, water, oils, cloth and other materials of particular interest to the textile chemist, special lecture notes and Griffin's "Technical Methods of Analysis" is used as a text.

TEXTILE ENGINEERING DEPARTMENT.

Mechanics and Mechanism (Courses VIa–VId).

This is one of the most important of engineering subjects and is therefore a subject common to all engineering courses. It deals with the principles which underlie the transmission of force and motion. Beginning with a discussion of such important topics as work, power, horsepower, energy and the like, the student then studies the fundamental mechanical principles which are exemplified by the lever, jackscrew, pulley block, inclined plane, wedge, differential pulley and other similar devices. This is followed by consideration of the simpler relations pertaining to uniform and accelerated motion and the course concludes with a study of pulleys, belting, gears and gearing, as far as time permits. No student should undertake this course who is not thoroughly familiar with such elementary mathematics as is described under Shop Mathematics.

Strength of Materials (Course VIa).

This interesting subject deals with the fundamental principles whereby the man engaged in machine, engine, mill, or building design may ascertain whether the parts are strong enough to carry the forces and loads which the nature of the construction imposes upon them. The fundamental stresses of tension, compression and shear are considered, together with the ultimate strength of cast iron, wrought iron, steel, and timber. The practical use of this information is illustrated in the design of bolts, tie rods, columns, wall piers, boiler shells, riveted joints, etc. This is followed by a study of the stresses in and design of beams under various conditions of loading, and the course concludes with a discussion of the torsional stresses and twist in shafts. A knowledge of the principles of Mechanics and Mechanism is necessary to a satisfactory understanding of this subject.

Mechanical Drawing (Course VIb).

This (Course VIb) is the complete course in drawing and requires two evenings per week for three years for its completion. The work in this course is so planned that at its completion a man shall be thoroughly familiar with the making of a working or shop drawing. After a study of the underlying principles of projections and instruction in penciling, inking, lettering and tracing, the subject of sketching and the making of detail drawings therefrom is especially stressed. The preparation of assembly drawings is finally considered. Shop mathematics is a prerequired subject.

Mechanical Drawing (Courses VIa-VId).

The work required in this subject follows the same plan as described for Course VIb. Although the time allotted to this subject is only one-half that given in Course VIb, nevertheless the student acquires a good knowledge of the fundamentals of mechanical drawing.

Electrical Drawing (Courses VIe–VIf).

The work given in this subject is intended to make the student familiar with electrical diagrams and machinery and is taken by those studying the Electrical Engineering Courses.

Steam (Course VIa).

The instruction in this subject covers, so far as time permits, the elements of steam engineering. The topics covered are heat and its measurement use of, steam tables, types of boilers, engines and turbines, boiler and engine room accessories, together with a study of the methods of testing the various types of apparatus. Actual tests on such equipment are made as the size of the class permits.

Electricity (Course VIa).

This subject deals with the theory and application of both alternating and direct currents. The main topics treated are —

Magnetism.	Simple alternating current circuits.
Theory of electric currents.	Wiring.
Direct current generators and motors.	Transmission.
Measuring instruments.	

Electricity — First Year (Courses VIe–VIf).

The fundamental properties of electrical and magnetic circuits are studied under this subject both in the class-room and laboratory. Other topics include the measurement of resistance, the calculation and measurement of power in direct-current circuits, and the relation between the electrical, heat and mechanical units of energy.

Electricity — Second Year (Courses VIe–VIf).

This subject depends upon the work done in the first year of Courses VIe and VIf. The design and operation of direct-current motors and generators are studied in the class-room and laboratory. A large amount of laboratory work is given to make the student familiar with methods of testing and controlling electrical machinery.

Electricity — Third Year (Course VIe).

A thorough knowledge of the theory and application of direct-current electricity is required before taking up this subject. Alternating current circuits are first studied, and then the design and operation of alternating current machinery are taken up. Some time will be devoted to the study of illumination and electrical measuring instruments. The instruction is given by means of lectures, recitations, and a large amount of laboratory work.

Mathematics — First Year (Courses VIa–VId).

This subject is a continuation of the work in Shop Mathematics, and is intended as a foundation for the advanced courses in engineering. Some of the topics treated are —

Elementary algebraic operations of —

Addition.	Division.
Subtraction.	Factoring.
Multiplication.	Fractions.

Mathematics — Second Year (Course VIa); First Year (Courses VIe–VIf).

Before taking this subject the student must have completed the work outlined in first year Mathematics and should be familiar with the essentials of plane geometry. A general outline of the subject follows:

Fractions.	Logarithms.
Graphical representation.	Slide rule.
Linear equations.	Trigonometry.
Radicals.	

Shop Practice.

This subject is covered by a series of lectures on care and management of machine-shop tools leading up to the actual operation of the same.

Shop Mathematics.

By this topic is meant the practical application of arithmetic, geometry and algebra to everyday problems. It includes briefly, addition, subtraction, multiplication, division, common and decimal fractions, ratio and proportion, common areas and volumes, and simple equations involving one unknown.

FINISHING DEPARTMENT.

Woolen and Worsted Finishing.

The outline of this course, which is given chiefly by means of lecture work, is as follows: —

Burling and Mending. — Under this head are taken up for consideration the examination of flannel as it comes from the loom; the construction, use and location of the perch; the methods used in marking defects, measuring, weighing and numbering of cloths; also the methods of inspection for fancies, single cloths and double

cloths. The object of burling, mending and the types of tables employed, the method of removing knots, runners, etc., the object of back shearing and the use of burling irons, the replacing of missing threads and the importance of sewing as a part of the finishing process, are all considered in detail. The removal of oil and tar spots as well as stains of various kinds is studied.

Fulling. — This branch covers a study of the conditions of the flannel as it comes from the loom, and the influence of oil, etc., upon the procedure. Considerable time is devoted to the various methods of producing a felt, the early types of stocks, hammer falling and crank stocks, and their modifications and development into the present type of rotary fulling mills of both the single and double variety. The details of construction in all machines are carefully taken up and include the design and composition of the main rolls, methods of covering, regulation and means of adjusting the pressure of traps and rolls, consideration of the shoes, the use and regulation of the various types of stop motion, the different types of stretchers, guide rolls and throat plates.

The theory of felt is taken up and the influence of pressure, moisture, heat, alkali and acid is considered, as well as the hydroscopic and felting properties of different wool fibers. The preparation of the flannel for the mill and the usual methods of determining shrinkages, as well as the various methods of soaping, are given careful attention. The preparation of various fulling soaps and the value of each for the production of various degrees of felt, as well as the determination of the proper amount of alkali for various goods, are carefully studied and demonstrated. The manipulation of the various kinds of goods in the mill, viz., all wool, shoddies and mixed goods, is studied in classroom and by operation in the mill.

The change in weight and strength for each operation is carefully considered, as is also the value of the flocks made in each. A study of the various methods of flocking, such as dry and wet, is considered in both class and machine rooms. In each operation the defects likely to materialize are studied, as well as the cause thereof, and various methods of modifying or lessening them.

Washing and Speck Dyeing. — This branch considers the scouring, rinsing and washing of goods both before and after the fulling process; the various types of washers; and the details of construction, such as suds box, rolls, etc. The theory of scouring, uses of Fuller's earth, salt solutions and sours on the different kinds of goods are made clear by practical work in the machine room, where the effects due to improper scouring, such as stains, cloudy effects, wrinkles and unclean goods, are demonstrated. The discussion of the necessity of speck dyeing follows naturally from the study of these matters, and includes methods of preparation, materials used, application and tests required.

Carbonizing. — This is an important branch of finishing, and includes a study of the various carbonizing agents, methods of application, strength of solutions and neutralizing, as well as the machines used. Stains and imperfections resulting from carbonizing are also considered. The drying and tentering machines and extractors employed are taken up at this point.

Gigging, Napping and Steaming. — The construction in detail of the various types of gigs, nappers, steamers, wet gigs, rolling, stretching, crabbing and singeing machines is discussed, and their actions upon the cloth and the results obtained are explained.

Various methods of obtaining luster and the production of permanent finish are considered in connection with steaming and sponging.

Brushing, Shearing and Pressing. — This includes, as do the other branches, a careful treatment of the machine employed, the preparation of the cloth for each process, the action of each machine in producing its part of the resultant effect. In manipulation of the shear consideration is given to its setting, grinding and adjustment. With the brushing machine the effect of steaming and moisture upon the luster and feel of the goods is shown. A study of the action of the presses, both plate and rotary, involves consideration of pressure, steaming, etc. Special processes to obtain particular effects are taken up, and the part played by each machine is explained. The details involved in handling cloth on a commercial scale, as, for example, measuring, weighing, ticketing, numbering and rolling, are also explained. The necessary calculation and the methods of finishing all grades of goods are considered from time to time during the year.

Cotton Finishing.

The outline of the course in the finishing of cotton fabrics is as follows: —

Cloth Room. — Instruction of the various goods and the object thereof; construction of the various types of inspecting and trimming machines.

Shearing. — The object. A consideration of the various types of shears for treating one or both sides at the same time; also the use of the usual cleaning devices, such as emery, sand and card rolls, beaters and brushes; grinding and the adjustment of the various parts.

The use of brushing and cleaning machines, rolling devices and calender attachments for gray goods.

Singeing. — Developing and object of singeing; the construction of singers of all types, and for various purposes; the use of cooling tanks, steaming devices, rolling and brushing attachments.

Regulation of the flame for various goods, and adjustment of the parts; gas and air pressure, water-cooled rolls; the effect of moisture on the cost of singeing; the use of dry cans in connection with singeing; electric singeing.

Washing. — Open width and string washers, their construction and operation; soaps, temperature, squeeze rolls; washing of various goods and the object thereof; stains.

Napping. — The object of napping and the usual method of treating goods; various types of nappers, single and double acting; felting nappers; construction, grinding and adjustment of various types.

Water Mangles. — Their object and the construction of various types; various rolls, — iron, husk, etc.; scutchers, their object and constructions.

Starch Mangles. — The object and construction of all types of starch mangles for pure starch and filled goods; various types of rolls, — brass, rubber, wood; action of doctor blades, etc.; regulation and object of pressure.

Methods of starching and finishing all standard goods, also a consideration of the various substances used, such as starch, softener and fillers; the preparation of starch and various methods of application.

Dryers and Stretchers. — Both horizontal and vertical, tenter frames, clips; the swing motion and the finishes thus produced; construction; spraying machines, belt stretchers, button breakers; their object and construction.

Calenders. — The object and construction of all types, including the regulation of pressure and nips for the production of various finishes; various types of rolls and their uses, — steel, husk and paper; the use of hot and cold rolls; chasing, friction, embossing and Schriner calenders and the various finishes produced by each; production of watered effects; beetling machines.

Making up room, — yarding, inspecting; different types of folds; pressing, papering, marking.

EVENING GRADUATES OF 1925.

Certificates awarded as follows, April 8, 1925: —

Course I (Cotton Manufacturing) — 4 Years.

Carlton Frederick Flynn	Lowell, Mass.
Henry Orville Hollingworth	Lowell, Mass.
Edward Joseph Small	Lowell, Mass.
Frank Frederick Twarog	Lowell, Mass.

Course Ia (Cotton Yarns) — 3 Years.

Bliss Anderson Bowser	Lowell, Mass.
Glendon Mandeville Elliott	Lowell, Mass.
Paul Peter Lutz	Lawrence, Mass.
George Thomas Randall	Lowell, Mass.
Russell Adams Wells	Boston, Mass.
Alfred Whitham	Lowell, Mass.

Course II (Wool Manufacturing) — 4 Years.

Clarence Tyrie Drummond	Lawrence, Mass.
George Harry Goff	North Andover, Mass.
Joseph Christian Ruess	Lowell, Mass.
William Friend Worsman	Methuen, Mass.

Course IIa (Woolen Yarns) — 2 Years.

Vincent Christopher Keily . . . . Lowell, Mass.

Course IIb (Worsted Yarns) — 2 Years.

Harry Joseph Bunting . . . . Lawrence, Mass.
Harold Ballard Walker . . . . Ballardvale, Mass.
Frederick Donisthorpe Webster . . . . Methuen, Mass.

Course IIIa (Cotton Design) — 3 Years.

James Howard Ewing . . . . Lawrence, Mass.
John Rogers Flather . . . . Lowell, Mass.
Charles Alexander Payer . . . . Tyngsboro, Mass.

Course IIIb (Woolen and Worsted Design) — 3 Years.

Robert Edward Cinqmars . . . . Lowell, Mass.
George Coates . . . . Andover, Mass.
Stanley Joseph Dziadosz . . . . Lawrence, Mass.
Frederick Kilby Hall . . . . Lowell, Mass.
Vincent Christopher Keily . . . . Lowell, Mass.
George Joseph Lariviere . . . . Lowell, Mass.
John Burgiel Liss . . . . Methuen, Mass.
George Frederick McNamara . . . . Lowell, Mass.
James Arthur Mellor . . . . Lawrence, Mass.
Fred Victor Priestley . . . . Lawrence, Mass.
Thomas Charles Sumner, Jr. . . . . Methuen, Mass.

Course IIIc (Freehand Drawing) — 3 Years.

Raymond Lapierre . . . . Lowell, Mass.
Gertrude Malkiel . . . . Lowell, Mass.

Course IVa (Elementary Chemistry) — 2 Years.

Joseph Hyacinth Clarke . . . . Lowell, Mass.
Edgar Ernest Dubray . . . . Nashua, N. H.
Theodore Kapala . . . . Lowell, Mass.
Victor John Krukonis . . . . Lawrence, Mass.
George Lawrence Morris . . . . Lawrence, Mass.
Paul Alfred Ouellette . . . . Lowell, Mass.
Thomas Gideon Reid . . . . Lowell, Mass.
Albert Henry Spurr . . . . Lawrence, Mass.

Course IVb (Textile Chemistry and Dyeing) — 3 Years.

George McCulloch Battye . . . . Lowell, Mass.
Edwin Adolf Buthmann . . . . Lawrence, Mass.
Thomas Phillips . . . . Lawrence, Mass.
Richard Siegel . . . . Lawrence, Mass.

Course IVc (Analytical Chemistry) — 3 Years.

Albert Hunt . . . . Lowell, Mass.

Course Va (Cotton Weaving) — 1 Year.

Glendon Mandeville Elliott . . . . Lowell, Mass.
Raymond Gates Flanders . . . . Nashua, N. H.
Carl Gustafson . . . . Dorchester, Mass.
Samuel Hardy . . . . Lowell, Mass.
Thomas Leo Hartley . . . . Lowell, Mass.
Joseph John Higginbottom . . . . Lowell, Mass.
George Sotnick . . . . Lowell, Mass.
Paul Edward Thorson . . . . Jamaica Plain, Mass.
Russell Adams Wells . . . . Boston, Mass.
Douglas Campbell Whitney . . . . Boston, Mass.
Charles Benjamin Winters . . . . Arlington, Mass.

Course Vb (Woolen and Worsted Weaving) — 2 Years.

Fred Victor Priestley . . . . Lawrence, Mass.

Course Vc (Dobby and Jacquard Weaving) — 1 Year.

John Rogers Flather	Lowell, Mass.

Course VIa (Mechanical Engineering) — 3 Years.

George Alfred Biron	Lowell, Mass.
Wilfred Edward Gionet	Lowell, Mass.
Frank Quance	Methuen, Mass.

Course VIb (Mechanical Drawing) — 3 Years.

Wilfred Edward Gionet	Lowell, Mass.
Vernon George Gattenby	Lawrence, Mass.

Course VId (Machine Shop) — 3 Years.

Alfred Graichen	Lawrence, Mass.
Arthur William Mann	Lawrence, Mass.

Course VIIa (Cotton Finishing) — 1 Year.

Richard John Audreoli	Lowell, Mass.
Clinton Roger Andrews	Lawrence, Mass.
John Rogers Flather	Lowell, Mass.
David Chapman Hardman	Lowell, Mass.
John Marshall Hood	Methuen, Mass.
Stephen Francis Howard, Jr.	Lowell, Mass.
James William Wallace Logan	Lowell, Mass.
John Kenneth McCaffry	Lawrence, Mass.
Thomas Christopher McGowan	Lawrence, Mass.
Robert McMurray	North Andover, Mass.
Karl Putnam Ricker	Salem, Mass.

Course VIIb (Woolen and Worsted Finishing) — 1 Year.

Charles Frederick Dalton	Andover, Mass.
Armand Jules Desilets	Lowell, Mass.
Ralph Seth Giffin	Lowell, Mass.
Edward Arthur McCarthy	Haverhill, Mass.
Harold Eugene Melvin	Billerica, Mass.
James Hamilton Morton	Andover, Mass.
Thomas Phillips	Lawrence, Mass.
Howard Bliss Schneidewind	Lowell, Mass.
George William Smith	Lawrence, Mass.
Walter Joseph Wilson	Lawrence, Mass.

SERIES 29, No. 2

November, 1925

BULLETIN

OF THE

Lowell Textile School

LOWELL, MASS.

Issued Quarterly

1925-1926

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Moody Street and Colonial Avenue

Publication of this Document approved by the Commission on Administration and Finance

2500 12-'25 Order 3650.

STUDY OF RELATION OF TWIST TO CONTRACTION IN A SINGLE COTTON YARN

The object of this investigation was to determine the relation which the twist in a single yarn bears to the contraction that takes place during spinning.

The plan of the investigation involved a comparison between the measured length of stock delivered from the front roll and the length of yarn wound upon the bobbin.

The work was carried out on a single thirteen yarn made from one inch S. M. cotton using twist multipliers from 2.75 to 6.75. The tests were carried out on a frame having 36 tape driven spindles running about 7500 r.p.m. The top rolls used were of the solid, single boss type on all three lines.

Two methods of measuring the delivery of yarn were adopted.

In one method of measuring the delivery the big intermediate gear in the end of the frame was used. A pin mounted in the side of this gear was used to turn a counting device mounted on the inside of the end, so that the revolutions and fractional revolutions of the gear could be determined: and from this as a base, the revolutions of the front roll and its delivery likewise.

The second method of determining the actual delivery from the front roll was by feeding a 40/2 of balanced twist in back of the front roll and allowing the yarn thus fed to wind upon the scavenger roll.

When in operation, one spindle produced yarn, while the same roll delivered the 40/2 for comparison with the yarn wound upon the bobbin. To check any error that might result from a possible difference in the nature of the top rolls, cross tests were made in which the 40/2 and the strand being spun were exchanged on each roll.

The length of delivery as calculated from the gearing was used as a check against the possible slipping of the top rolls.

With each different twist used, an effort was made to secure about one hundred yards on each of the eighteen spindles that were producing yarn.

At the beginning of each test the strands were marked directly in front of the front roll and again at the end of each run.

At the end of each run, both the yarn which had been spun and the 40/2 delivered by the same roll were reeled on a cotton reel and measured. Care was used to keep tensions uniform throughout the reeling and the length was recorded to the nearest half inch.

A comparison of the length of 40/2 and the length calculated from reading the counter showed very similar results, the variation being less than one per cent in every instance.

TABULATION OF CONTRACTION

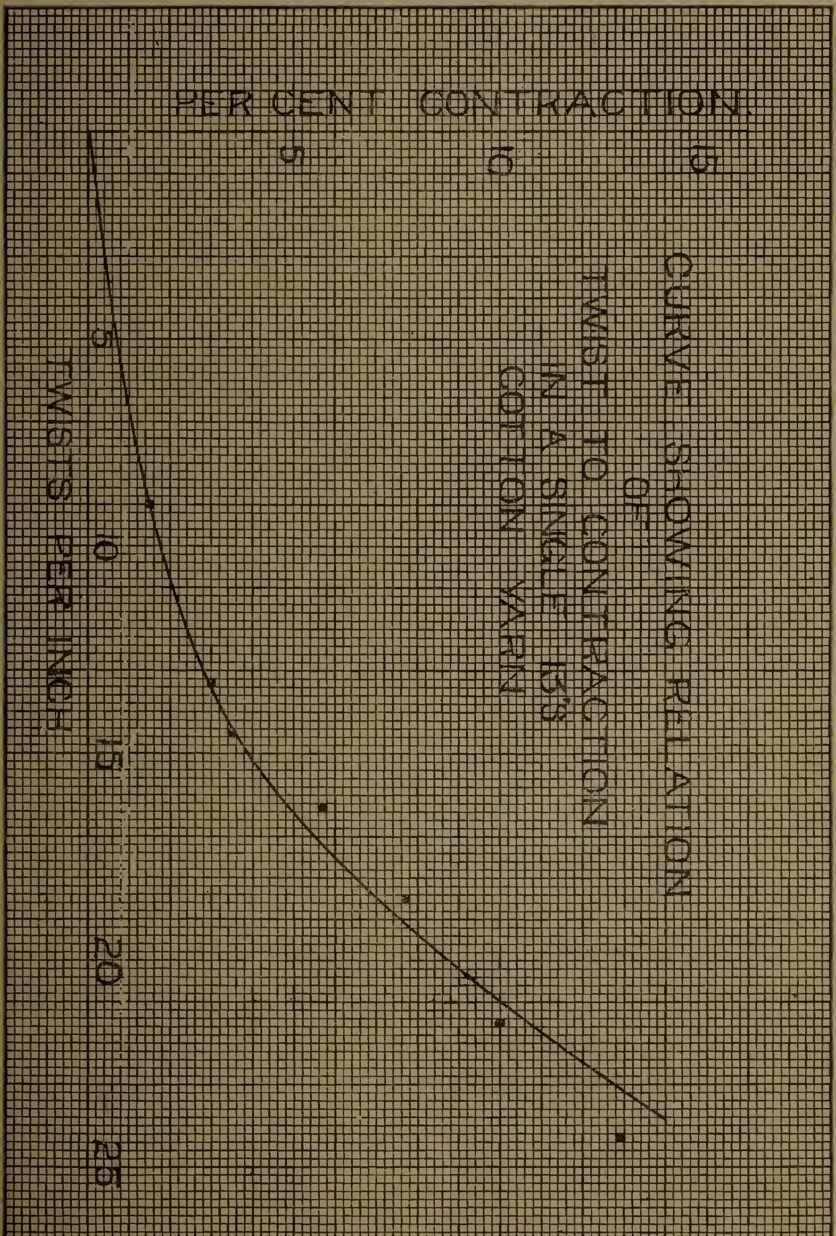
Twist Multiplier	*First Test*	*Gross Test*	*Average*
6.74	13.64%	11.76%	12.70%
5.98	10.10%	9.73%	9.90%
5.10	7.57%	7.70%	7.68%
4.48	5.40%	6.07%	5.74%
3.99	3.65%	3.08%	3.36%
3.50	2.89%	3.12%	3.00%
2.50	1.53%	1.36%	1.49%

The table above shows a summary of the results secured. Each figure is the result of averaging all the lengths of yarn wound without a break upon the bobbins and comparing this figure with the lengths of 40/2 delivered during the same interval.

In calculating the per cent of contraction the length of the 40/2 measuring yarn has been taken as a base.

The curve following shows that the tendency of the yarn to contract grows greater as the twist increases.

NOTE:—This is one of a series of similar studies in yarn manufacturing which have been conducted in the Cotton Yarn Laboratory of the Lowell Textile School. It is not looked upon as being the final word in matters of yarn contraction and criticism of it will be much appreciated.



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BULLETIN

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LOWELL, MASS.

Issued Quarterly

1926

[illegible]

Moody Street and Colonial Avenue

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CALENDAR.

1925–1926

September 17–18, Thursday–Friday	Entrance Examinations.
September 21–26, Monday–Saturday	Re-examinations.
September 28, Monday	Registration.
September 29, Tuesday	First term begins.
October 12, Monday	Columbus Day — Holiday.
November 24, Tuesday 4.20 P.M.	Thanksgiving recess begins.
November 30, Monday 9.00 A.M.	Thanksgiving recess ends.
December 18, Friday 4.20 P.M.	Christmas recess begins.
January 4, Monday 9.00 A.M.	Christmas recess ends.
January 25, Monday	First term examinations begin.
February 5, Friday	End of first term.
February 8, Monday	Second term begins.
February 22, Monday	Washington's Birthday — Holiday.
April 14, Wednesday 4.20 P.M.	Spring recess begins.
April 20, Tuesday 9.00 A.M.	Spring recess ends.
May 24, Monday	Second term examinations begin.
May 31, Monday	Holiday, observance of Memorial Day.
June 8, Tuesday	Commencement.
June 10–11, Thursday–Friday	Entrance Examinations.

1926–1927.

September 16–17, Thursday–Friday	Entrance Examinations.
September 20–25, Monday–Saturday	Re-examinations.
September 23, Thursday 9.00–12.00 A.M.	Registration for Freshmen.
September 27, Monday	Registration for upper class students.
September 28, Tuesday	First term begins.
October 12, Tuesday	Columbus Day — Holiday.
November 23, Tuesday 4.20 P.M.	Thanksgiving recess begins.
November 29, Monday 9.00 A.M.	Thanksgiving recess ends.
December 21, Tuesday 4.20 P.M.	Christmas recess begins.
January 3, Monday 9.00 A.M.	Christmas recess ends.
January 24, Monday	First term examinations begin.
February 4, Friday	End of first term.

TRUSTEES OF THE LOWELL TEXTILE SCHOOL.

OFFICERS OF INSTRUCTION AND ADMINISTRATION.

Charles Holmes Eames, S.B., Billerica.
President.

Hermann Henry Bachmann, 146 Parkview Avenue.
Professor of Textile Design; in charge of Department of Design and Weaving.

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Professor of History and Economics; in charge of Languages, History and Economics; Secretary of the Faculty

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Arthur Andrew Stewart, 56 Robbins Street.
Professor of Textiles; in charge of Department of Finishing.

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Instructor in Weaving.
AI EDWIN WELLS, 204 Franklin Street, Melrose Highlands.
Instructor in Electrical Engineering.
EMMA ELIZABETH WHITNEY, 137 Riverside Street.
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JOSEPH ADRIEN LUSSIER, 793 Merrimack Street.
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Assistant Instructor in Machine Shop Practice.
HENRY EARL MCGOWAN, 36 Varney Street.
Assistant Instructor in Mechanical Drawing.
SAMUEL MEEKER, 295 Foster Street.
Assistant Instructor in Chemistry.
HARRY LEROY SWAIN, 115 Mount Vernon Street.
Assistant Instructor in Cotton Yarns.
ELMER PERCY TREVORS, 241 Hildreth Street.
Assistant Instructor in Chemistry.
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Bursar.
FLORENCE MOORE LANCEY, 46 Victoria Street.
Librarian.
MONA BLANCHE PALMER, 685 Westford Street.
Clerk.

THE LOWELL TEXTILE SCHOOL.

History. — The Lowell Textile School was established by the Trustees of the Lowell Textile School of Lowell, Massachusetts, incorporated in accordance with chapter 475, Acts of 1895. The movement for the establishment of the school dates from June 1, 1891, but it was not opened for instruction until February 1, 1897.

In accordance with the acts of incorporation the Board of Trustees consisted of twenty permanent and self-perpetuating members, three-fourths of whom must be "actively engaged in, or connected with, textile or kindred manufactures." In addition, His Honor the Lieutenant-Governor, the Commissioner of Education of the State, the mayor, the president of the municipal council, the superintendent of schools of Lowell, and a representative of the textile council were members *ex officio*. Legislative acts of 1905 and 1906 authorized the graduates of the school to elect four trustees serving for periods of four years each.

By virtue of the anti-aid amendment to the State Constitution, and by chapter 274, General Acts of 1918, the property of the school was transferred on July 1, 1918, to the Commonwealth of Massachusetts, and the control and management of the school was vested in a Board of Trustees appointed by the Governor, "with all the powers, rights and privileges and subject to all the duties" of the original Board.

In locating the school at Lowell, which has been called the "Mother Textile City of America," considerable advantage is secured by close association with every branch of the industry, which utilizes almost every commercial fiber in the products of the great Merrimack Valley textile district.

Although the school was formally opened by Governor Roger Wolcott on January 30, 1897, in rented quarters in the heart of the city, it was not until January, 1903, that the first buildings of the present plant were ready for occupancy. On February 12, 1903, Governor John L. Bates dedicated the present buildings.

Object. — The object of the establishment of the school as set forth in the original act was "for the purpose of instruction in the theory and practical art of textile and kindred branches of industry."

The plan was occasioned by the apparent crisis in the leading industry of New England, due to the rapid development of the manufacture of the coarser cotton fabrics in the southern States. It was believed that this crisis could be met only by a wider and more thorough application of the sciences and arts in the production of finer and more varied fabrics.

Following the general methods and systems found successful at the higher polytechnic institutes, it offers thorough instruction in principles of the sciences and arts applicable to textile and kindred branches of industry. The courses treat not only of the theory but also the application of these principles in the processes, on the machines and throughout all departments of industry involved in the successful manufacture, application and distribution of textile material in any form.

Because of the breadth, grade and character of instruction given, and because of the standing and personnel of the instructing staff, the school has been placed by both Federal and State educational boards in the class of the higher technological schools of this country.

Though from the first the management has kept in view the clearly defined objective which called for the establishment of the school, to meet the needs of the textile and kindred industries, it has developed its curriculum, its methods of instruction, and equipment as those needs arose. This objective will be kept constantly in view, and as new demands are presented an effort will be made to extend courses, equipment and floor space. The mechanical equipment of the school includes the best makes of textile machinery, and these machines, while built as they would be for regular work, are, as far as possible, adapted to the experimental work which is of particular value in such an institution as this. There is a more varied equipment in this school than in any other, either in America or Europe, and it is now possible to convert the raw stock into the finished fabric within the school.

The day classes have been organized for those who can devote their entire time for three or more years to the instruction requisite in preparing to enter the textile

industries. It has been found necessary to require of all such students educational qualifications equivalent to those given by a regular four-year course of a high school or academy of good standing.

The evening classes are held for about twenty weeks of the year, and are for those who are unable to attend the day courses. These are similar to the day courses, but are aimed especially to meet the needs of students working during the day in the mills and shops. For entrance to these classes an applicant should have the equivalent of a grammar school education. A detailed description of these courses and requirements is given in another Bulletin, which will be sent upon request.

The trustees and faculty of the school confer the degrees of Bachelor of Textile Engineering (B.T.E.) and Bachelor of Textile Chemistry (B.T.C.) upon those students who satisfactorily complete one of the prescribed four-year courses. A diploma is awarded to those who satisfactorily complete one of the three-year courses.

DAY CLASSES.

ENTRANCE REQUIREMENTS.

Degree Courses.

Candidates for admission to either of the degree courses must be graduates of a school approved by the New England College Entrance Certificate Board or by the Board of Regents of New York, and must present a certificate from the principal of the school last attended, reporting upon the subjects pursued and the points obtained according to the schedule of studies given hereafter. A total of fourteen points is required.

A point represents satisfactory work in a year's study in a specified subject in an approved secondary school.

Required Subjects.	Points.
Algebra A1	1
Algebra A2	1
English	3
Elementary French A (two years) or Elementary German A (two years)	2
Plane Geometry	1
History (American, Mediæval and Modern, or English)	1
Physics	1
	10

Elective Subjects.	
Chemistry	1
English	1
Elementary French (two years) or Elementary German (two years)	2
Advanced French of German (one year in addition to requirements of Elementary French A or Elementary German A)	1
History:	
American	1
Mediæval and Modern	1
English	1
Latin	1
Mechanical Drawing	1
Mechanic Arts	1
Solid Geometry	1
Spanish	1
Trigonometry	1

An applicant may also be admitted on the basis of entrance examinations in which case he must pass a sufficient number of the required subjects to make ten points, and present certificates showing satisfactory courses in such of the elective subjects to make four additional points.

The objective of the elective requirements is to encourage greater breadth of preparation than that covered by the required branches. Certificates covering other subjects than those listed as elective will be entertained.

Diploma Courses.

Candidates for admission to the diploma courses are accepted upon presentation of properly vouched certificates showing the completion of a regular four-year course in a high school or academy of reputable standing. The certificate must specify that the applicant has satisfactorily passed the required subjects.

A total of twelve points is required.

Required Subjects.	Points.
Algebra A1	1
Algebra A2	1
English	3
Plane Geometry	1
History (American, Mediæval and Modern, or English)	1
Physics	1
	8

Elective Subjects.

Four may be selected from the list under Degree Courses.

ENTRANCE EXAMINATIONS.

All students who are unable to present a certificate for either the degree or the diploma courses must pass entrance examinations. Notification of intention to take these examinations must be made in writing at least a week before the date of the examinations. These will be held as follows: —

Thursday, June 10, 1926; Thursday, September 16, 1926; Thursday, June 9, 1927:—
Algebra, 9 A.M. to 11 A.M.
History, 11 A.M. to 1 P.M.
English, 2 P.M. to 4 P.M.

Friday, June 11, 1926; Friday, September 17, 1926; Friday, June 10, 1927: —
Plane Geometry, 9 A.M. to 11 A.M.
German or French, 11 A.M. to 1 P.M.
Physics, 2 P.M. to 4 P.M.

Candidates failing to pass the June examinations are allowed to try again in September; those who cannot attend the June examinations may present themselves in September.

REQUIRED SUBJECTS FOR ENTRANCE.

Algebra A1. — Fundamental operations, factoring, determination of the highest common factor and least common multiple, fractions, simple and complex, simple equations of one or more unknown quantities, problems involving linear equations of either numerical or literal quantities, radicals, involution and evolution, square and cube root, ratio and proportion, exponents including fractional and negative.

Algebra A2. — Quadratic equations both numerical and literal. Simple problems involving one or more unknown quantities that may be solved by the methods of linear or quadratic equations, binomial theorem for positive integral exponents, problems involving methods of arithmetical and geometrical progressions.

Plane Geometry. — The usual theorems and constructions of good textbooks, including the general properties of plane rectilinear figures, the circle and the measurement of angles, similar polygons, areas, regular polygons, and the measurement of the circle. The solution of original problems and problems in mensuration of lines and plane surfaces.

English. — As secondary schools are following to a greater extent than heretofore the requirements of the College Entrance Examination Board, it is recommended that the applicant to this school conform to the suggestions of this Board relative to English composition and literature.

The examination consists of two parts, both of which are given at the same time.

(*a*) With the object of testing the student's ability to express his thoughts in writing clearly and correctly he will be required to write upon subjects familiar to him. Emphasis will be laid upon the composition, punctuation, grammar, idiom and formation of paragraphs. He will be judged by how well he writes rather than by how much he writes.

(*b*) The second part of the examination is prepared with the view of ascertaining the extent of the student's knowledge of good literature, and to test this examination questions will be based on the books adopted by the National Conference on Uniform Entrance Requirements. Any course of equivalent amount if made up of standard works will be accepted.

Modern Languages.

REQUIREMENTS FOR DEGREE COURSES.

It is expected that the work in these subjects has covered a period of at least two years of preparatory school training or the equivalent. Importance should be given to the ability to translate into good idiomatic English, but attention should also be paid to grammar and construction, that greater care may be used in translation.

Elementary German A. — The entrance examination is composed of two parts, both taken, however, at the same time.

(*a*) Translation of simple German prose into good idiomatic English.

(*b*) Questions to test proficiency in grammar, and simple English sentences to be rendered into German.

The requirements include the declension of articles, adjectives, pronouns and nouns; the conjugation and inflection of weak and strong verbs; the simpler uses of the subjunctive; the use of the modal auxiliaries; the prepositions and their uses; the principal parts of important verbs; and the elementary rules of syntax and word order.

Texts used in the language courses of any reputable high or preparatory school will furnish reading for translation. A list of texts is offered by the College Entrance Examination Board.

Elementary French A. — The entrance examination is composed of two parts, both taken, however, at the same time.

(*a*) Translation of simple French prose into good idiomatic English.

(*b*) Questions to test proficiency in grammar, and simple English sentences to be rendered into French.

The requirements include the principal parts, conjugation and inflection of the regular and the more common irregular verbs; the singular and plural forms of nouns and adjectives; the uses of articles and partitive construction; the forms and positions of personal pronouns; and the simpler uses of the conditional and subjunctive.

Suitable texts are suggested by the language courses of any reputable high or preparatory school and by the requirements of the College Entrance Examination Board.

Students who have pursued two years of elementary French as well as two years of elementary German may present one subject to cover two points in the required subjects, and the other to cover two points in the elective subjects.

History.

Applicants may offer a preparation of American history, English history or mediæval and modern history.

In American history applicants should be familiar with the early settlements in America, the colonies, their government, the customs of the people, and events which led to the establishment of the United States. They should be informed concerning the causes and effects of the principal wars in which the country has been involved. They should be prepared to consider also questions requiring an elementary knowledge of civil government, as well as historical facts connected with the growth of this country up to the present time.

For the subject of English history or mediæval and modern history the course given in any reputable secondary school should give proper preparation. A course extending over a full year with not less than three periods a week will be accepted.

Physics.

The applicant should be familiar with the fundamental principles of physics, particularly those considered under the headings of mechanics, heat, light, electricity and magnetism. Textbook instructions should be supplemented by lecture table experiments. Wherever possible, the student should pursue a laboratory course, but for the present no applicant will be conditioned in this subject if he has not been able to carry on a laboratory course. Where a laboratory course is offered by a secondary school, it should cover at least twenty-five of those experiments listed in the syllabus of the College Entrance Examination Board. An applicant should present his notebook, together with the certificate from the teacher under whom the work was performed.

ELECTIVE SUBJECTS.

History. — If the applicant can present all three or any two branches of history specified he may include one as a required subject and the others in the list of elective subjects.

Chemistry. — Applicants must show evidence of their familiarity with the rudiments of chemistry. Any course given in a secondary school organized to

present instruction by means of textbook or lecture, together with correlated laboratory work, will be considered as covering the requirements. The applicant's notebook with his original notes, including description of experiment, apparatus used, reactions, observations and deductions, must be accompanied by his instructor's certificate.

Importance will be placed upon manipulation and deductions as well as the general appearance and neatness of the notebook.

Solid Geometry. — The usual theorems and constructions of good textbooks, including the relations of planes and lines in space, the properties and measurement of prisms, pyramids, cylinders and cones; the sphere and spherical triangles. The solution of original problems and the applications of the mensuration of surfaces and solids.

Trigonometry. — The usual courses of instruction covered by the standard textbooks on plane and spherical trigonometry will prepare an applicant sufficiently to meet this requirement.

Mechanical Drawing. — The applicant must have pursued such a course in mechanical drawing that he will be familiar with the usual geometrical construction problems, projection of points, lines, planes and simple solids.

Importance is laid not only upon the accuracy with which the work is performed, but upon the general arrangement, appearance and care with which the plates are executed.

It should not be understood that work in this subject may be offered as the equivalent of the first term's work at the school.

Mechanic Arts. — The usual courses offered by properly equipped preparatory schools will be accepted as suitable fulfillment of this requirement. Work should include instruction in the handling of both wood and metal working tools in the more simple practices of these arts.

Elementary French B. — Applicants who enter for one of the three-year courses may present one year's work in French in a secondary school. Those who present themselves for examinations in this subject should be familiar with the rudiments of grammar, and be able to translate simple French prose into good idiomatic English, also to translate into French English sentences, based on the French given for translation.

Elementary German B. — Applicants who enter for one of the three-year courses may present one year's work in German in a secondary school. What is stated in regard to French applies to those who may present German instead of French.

Advanced French or German. — In cases where applicants have pursued courses in French or German for more than two years, and have completed work which is more advanced than is included under elementary French or German, they may offer the additional year as an elective.

English. — In many secondary schools this subject is required during all of the four years, and where it is pursued to this extent the applicant may offer the additional year's work as one of his elective subjects.

Spanish. — Students offering Spanish should be familiar with elementary grammar, the common irregular verbs, and be able to translate simple Spanish to English or English to Spanish. A preparation equivalent to three periods per week for two years will be acceptable.

Latin. — Students who have pursued one or more years of Latin may present this subject as an elective. Each year's work satisfactorily completed will be considered equal to one point.

GENERAL INFORMATION

Preparation. — Particular stress should be laid upon a thorough grounding in mathematics, including algebra, arithmetic and plane geometry, as these form the basis upon which the work of this school rests. While solid geometry is not required at the present time, the student will find a knowledge of this subject very valuable in his subsequent work, and is strongly recommended to include this subject as one of his electives. A preliminary course in science, including physics, and chemistry, serves to prepare the student's mind for the higher branches of these subjects and their application, but neither will be considered as the equivalent of the courses in these branches given in the school.

Advanced Standing. — Candidates who may have received previous training in any of the subjects scheduled in the regular course will, upon presentation of acceptable certificates, be given credit for such work.

Registration. — All students are required to register on or before the Monday of the week beginning the school year, and again during the midyear examination period. For unexcused delay in registration a fee of $5 will be imposed.

Application Blanks. — A blank form of application for admission may be found at the end of this bulletin. This should be properly filled out by all applicants, whether entering upon certificate from a secondary school or presenting themselves for examination.

Fees. — The fee for the day course is $150 per year for residents of Massachusetts. For non-residents the fee for all courses is $200 per year. The fee for students from foreign countries is $300 per year.

Three-fifths of the fee is charged for a single term. Each term's tuition is payable during the first week of that term. Students failing to make this payment at the specified time will be excused from classes until satisfactory explanation and arrangements for payment can be made. *No bills will be sent.* After payment is made no fee or part thereof can be returned, except by special action of the trustees.

An athletic fee of $15 is due and payable at the time of the first payment of tuition.

Special students pay, in general, the full fee, but if a course be taken involving attendance at the school during a limited time, application may be made to the president for a reduction.

Students must provide their own books, stationery, tools, etc., and pay for any breakage or damage that they cause. The above fee includes free admission for any day students desiring to attend any of the evening classes in which there is accommodation.

For all first-year students a minumum deposit of $25 is required to cover the cost of breakage, supplies, and apparatus and chemicals used in the Chemical Laboratory, the unexpended balance to be returned to the student at the end of the year.

For all students in second, third and fourth years taking work in Chemistry and Dyeing Laboratories a deposit of $25 for the first term and $25 for the second term is required. Students taking Machine Shop will be required to make deposit of $15 to cover cost of materials, supplies and breakage. Included in this charge is a kit of tools which is essential to the work and which becomes the personal property of the student. The unexpended balance will be returned at the end of the year.

Students not taking Chemistry Laboratory or Machine Shop will be required to make a deposit of $15 each year to cover general breakage. The unexpended balance will be returned at the end of the year.

All deposits must be made before students can be admitted for laboratory work.

Examinations. — For first-year students intermediate examinations are held every five weeks, and these serve to inform the student concerning his standing and the progress made.

For students in upper classes informal examinations will be held during the eighth week of each term.

Formal examinations are held at the end of each term.

In general, the examinations cover the work of the preceding term, but at the discretion of the instructor may include work of earlier terms.

Examinations for students conditioned in first-term subjects are held during the second term, and examinations for students conditioned in the second-term examinations are held in September following. Students requesting condition examinations at other than scheduled dates will be required to pay $5 for each examination so taken.

Any student who fails to complete a subject satisfactorily or to clear a condition at the time appointed, will be required to repeat or drop the subject, and he cannot be admitted to subjects dependent thereon.

A student whose term's standing is as a whole so low that he cannot continue with profit the work of the next term will be required to leave school, but he may return the following year to repeat such subjects as are required.

Daily work and regularlity of attendance are considered in making up the reports of standing.

Continued or persistent absence or tardiness from the classes is considered reason to exclude a student from the class.

Records and Reports of Standing. — During each term informal reports are sent to parents or guardians of all students under age, and to all students; and at the end of each term formal reports are made.

The daily work of the student forms an important part of his record, and no pupil will be awarded the diploma or degree unless this portion of his record is clear.

Books are prescribed for study, for entry of lecture notes and other exercises, and are periodically examined by the lecturers. The care and accuracy with which these books are kept are considered in determining standing.

Attendance. — Attendance is required of all students on fourteen-fifteenths of all scheduled class exercises, provided they meet the requirements of their instructors for the omitted exercises. For every unexcused absence from any class exercise in excess of those allowed, a deduction from the mark obtained in the course in which the absences occurred will be made.

Advisors. — Advisors are appointed for all students, to be of such aid and assistance as they can both inside and outside of school hours. The head of the department in which a student is registered is advisor to upper classmen, and instructors in charge of freshman classes act as advisors to freshmen.

Thesis. — Each candidate for the degree of the school must file with the head of the department in which the thesis is taken, and not later than May 15, a report of original investigation or research, written on a good quality of paper, 8 by 10 inches, with 1-inch margin at left, and one-half inch at right, of each page; such thesis to have been previously approved by the head of the department in which it is made.

For all candidates for the diploma this requirement will be optional on the part of the school.

Graduate Course. — Graduates of technical courses of other schools are invited to communicate with the president with reference to special courses in the textile studies. Previous training in the sciences and the engineering branches will usually reduce materially the time necessary to complete any of the courses at this school. The advantages offered to such persons for special research work are unexcelled, and a most profitable course may be arranged.

Degrees. — The degree of Bachelor of Textile Engineering will be awarded for the completion of the four-year course in textile engineering. The degree of Bachelor of Textile Chemistry will be awarded for the completion of the four-year course in chemistry and textile coloring.

Diploma. — For the present the diploma of the school will be awarded upon the satisfactory completion of any one of the regular three-year courses. In cases where students obtain advanced standing, at least one year's attendance is required before the diploma can be obtained.

Conduct. — Students are required to return to the proper place all instruments or apparatus used in experimental work, and to leave clean and in working order all machinery and apparatus with which they may experiment. All breakages, accidents or irregularities of any kind must be reported immediately to the head of the department or instructor in charge.

In case of either day or evening students, irregular attendance, lack of punctuality, neglect of either school or home work, disorderly or ungentlemanly con-

duct or general insubordination are considered good and sufficient reasons for the immediate suspension of a student, and a report to the trustees for such action as they deem necessary to take.

It is the aim of the trustees so to administer the discipline of the school as to maintain a high standard of integrity and a scrupulous regard for trust. The attempt of any student to present, as his own, work which he has not performed, or to pass any examination by improper means, is regarded by the trustees as a most serious offence, and renders the offender liable to immediate suspension or expulsion. The aiding or abetting of a student in any dishonesty is also held to be a grave breach of discipline.

Any student who violates these provisions will be immediately suspended by the president, and the case reported at the following meeting of the trustees for action.

Library and Reading Room. — That the students may have surroundings conducive to reading and study a moderate-sized reading room with library tables and chairs has been provided. The library shelves contain textile, art, engineering and scientific publications. These are increased from time to time as new technical books of value to textile students are issued from the press. The leading textile papers are kept on file for ready reference.

Sessions. — The regular school sessions are in general from 9.00 A.M., to 12.40 P.M., and from 1.40 to 4.20 P.M., except Saturdays, when there is no session of the school. On Saturday afternoons the buildings are closed.

An hour plan designates the hours at which the various classes meet. This is rigidly adhered to, and the student is marked for his attendance and work as therein scheduled.

Residence and Expenses. — Students from a distance, requiring rooms and board in the city, may, if they desire, select the same from a list which is kept at the school. The cost of rooms and board in a good district is from $12 per week upwards.

All raw stock and yarn provided by the school, and all the productions of the school, remain, or become, the property of the school, except by special arrangement; but each student is allowed to retain specimens of yarn or fabrics that he has produced, if mounted and tabulated in accordance with the requirements of the school. It is understood that the school may retain such specimens of students' work as they may determine.

Lockers are provided for the use of the students, sufficiently capacious to contain clothing, books and tools.

No books, instruments or other property of the school are loaned to the students to be removed from the premises except by special permission.

Scholarships. — The Massachusetts Charitable Mechanic Association have offered four scholarships of $250 each which are for the purpose of defraying school expenses of such students as may be selected by a committee composed of a representative from the Association, one from the Board of Trustees and the President of the School.

Herbert A. Currier of the class of 1906 has offered a prize of $100 to a student who may be selected by the faculty of the school, and in making the selection the following conditions will be considered: scholastic standing, financial need, and ability in promoting student activities in school life. Scholarship to be available to some member of the sophomore, junior or senior classes.

Medals of Honor. — The National Cotton Manufacturers' Association offers annually a medal to that member of the graduating class who shall have during his course attained the highest standing in the special subjects required by the vote of the association.

Special Awards of Merit. Louis A. Olney Book Prize.

Prizes in the form of books are awarded each year to the successful candidates on graduation day. The conditions in detail are as follows: —

First. — Ten dollars to the student taking the regular Chemistry and Textile Coloring Course who shall be considered as having attained the highest scholarship in first-year chemistry.

Second. — Five dollars to the student taking the regular Chemistry and Textile Coloring Course, who shall be considered as having attained the second highest scholarship in first-year chemistry.

Third. — Ten dollars to the regular student of the Chemistry and Textile Coloring Course who shall be considered as having attained the highest scholarship during his second year.

Fourth. — Five dollars to the regular student of the Chemistry and Textile Coloring Course who shall be considered as having attained the second highest scholarship during his second year.

Fifth. — Twenty dollars to the regular student in the Chemistry and Textile Coloring Course who shall present the best thesis preparatory to graduation.

The above-mentioned sums are to be invested in books which may be selected after graduation. In case no one is considered worthy of any particular scholarship prize, or if there is no competition, the same may be withheld. The decision in such case shall rest with the judges.

Edward A. Bigelow Prize. — Edward A. Bigelow, class of 1906, has offered the following cash prizes: $100 to the member of the graduating class from the Wool Manufacturing course who maintains the highest standing throughout his three years; $50 to the member of the second year class in the Wool Manufacturing course who maintains the highest standing during his second year; $25 to the member of the first year class in the Wool Manufacturing course who maintains the highest standing during his first year.

Saco-Lowell Prize. — The Saco-Lowell Machine Shop of Lowell, Mass., offers a prize of $100 for the thesis prepared for graduation which will be considered of greatest value to the textile industry. Only candidates for a degree are eligible for this prize and the selection is to be made by a board comprised of three members, one from the Saco-Lowell Shops, one from the National Association of Cotton Manufacturers and one from the Lowell Textile School.

Textile Colorist Award. — The Textile Colorist, Inc., has offered a prize of $100 to be awarded to a member of the graduating class whose thesis, based upon his personal researches and experiences, is of the greatest practical value to the dyeing, bleaching or textile finishing industries.

Awards. — Gold medal, Paris Exposition, 1900, for general excellence. A special medal, Merchants and Manufacturers Exposition, Boston, 1900. The Pan-American medal, awarded to the school, 1901. Gold medal, Louisiana Purchase Exposition, 1904. Gold medal, Lewis and Clark Centennial Exposition, 1905. Medal of honor from Panama-Pacific International Exposition, 1915.

Bulletins and Catalogues. — All students registering and paying the regular fee for the course selected are entitled to the bulletins and catalogues when issued.

COURSES OF INSTRUCTION.

Since its establishment the Lowell Textile School has offered courses, each of which extends over a three-year period. With the development of the school, and close study of the problems presented to the graduates it has been found that attention should be given those branches of instruction which would give breadth of training as well as establish fundamental principles. This policy has resulted in extending the curriculum to such length that the need for an additional year's instruction was evident.

The fact was also appreciated that to carry on the more advanced work a better preparation must be demanded of the applicant for entrance.

Nevertheless, it was recognized that many young men seeking employment in the textile industry do not care, or are not in a position, to devote four years to scholastic preparation, and for these the regular three-year courses are offered.

These courses are designated as Cotton Manufacturing, Wool Manufacturing and Textile Design (General Textile Courses), upon completion of any one of which the regular diploma of the school is awarded.

In general, it is assumed that students pursuing these courses will not take the advanced work of the fourth year. However, if a student electing one of the three-year courses desires to change to one of the four-year courses he may do so providing his preparation and undergraduate standing permit it.

The four-year courses are Textile Engineering, Chemistry and Textile Coloring. At the completion of these courses the degrees of Bachelor of Textile Engineering (B.T.E.) and Bachelor of Textile Chemistry (B.T.C.) are conferred.

Three options are offered in the Engineering Course, viz., general textile, cotton manufacturing or wool manufacturing. Each of these courses is planned to train one in the fundamental principles of science found to be applicable in the particular fields of textile chemistry and textile engineering. It is maintained that for one to be successful in either of these important branches of industry a training is required as thorough and broad as that of any of the recognized branches of engineering or of applied science.

With this in mind these courses have been built of a secure framework of science and mathematics, and to it has been added the useful application of these branches in the broad textile field. With the direct purpose of laying a secure foundation in the training, a more extended preparatory course is first demanded, and subsequently in the school work more subjects of a general character are included, that narrowness of judgment and observation may not result by overstimulation of the technical development.

COURSES FOR WOMEN.

Although all classes are open to women, the courses which have appealed especially to their tastes have been textile designing and decorative art. Some have pursued courses in chemistry, and have added to their work in design some instruction in power weaving and finishing. These special courses have in general been followed for three years, and in some cases have led the students to positions either in the mill office or in some commercial lines that have been desirable and have offered congenial work.

Within the last few years the possibilities for women in certain branches of textile chemistry have become recognized, and it is believed that in the future the positions open to them will become more and more numerous.

GOVERNMENT POSITIONS.

One of the significant and important facts that has been clearly demonstrated during the recent conflict is the great value of a technical education. In no war has the applied science been so forcefully used as a weapon of combat.

An earlier catalogue pointed out the calls that the various departments of the government were making for graduates from this school in common with those of other technological institutions. The success attained by past students has been presented in a previous bulletin. As these men have shown their value to the government in times of war, so will they in times of peace. Before the war

various departments of the government had found need for graduates from this textile school, and with the problems of peace the need undoubtedly will become greater.

The United States Civil Service Commission recognizes graduates from the degree courses of this school as proper applicants for the examination to the various positions requiring a knowledge of applied science and engineering, as well as a knowledge of textile manufacturing, in the different departments of the government.

COURSES.

In the column headed "Hours of Exercise" the numbers represent for each particular subject the total hours required in school for a period of fifteen weeks.

The letter and number which follow the subjects indicate the department in which the subject is given and the number of the subject in that department. For detailed description of the same, see page 30.

The departments are indicated as follows: —

Textile Engineering	B	Cotton Yarns	F
Chemistry and Dyeing	C	Woolen and Worsted Yarns	G
Textile Design and Power Weaving,	D	Finishing	H
Languages and History	E		

By referring to the letter and number indicated under "Preparation" the student can ascertain what subjects are necessary in order that he may have a clear understanding of the subject which he is scheduled to take.

First Year.

First Term.

[Common to all courses.]

	Hours of Exercise.
Mechanics B–3	60
Mechanical Drawing B–7	90
Mathematics B–1	45
Textile Design D–1	90
Elementary Chemistry C–1	165
English E–1	45
Physical Education	30

Second Term.

	Course IV	Course VI
Mechanism B–4	60	60
Mechanical Drawing B–8 and B–9	30	90
Mechanical Laboratory B–6	–	30
Mathematics B–1	45	45
Textile Design D–1	–	60
Elementary Chemistry C–1	75	75
Technology of Fibers F–1, G–1 and C–2	60	60
English E–1	45	45
Elementary German E–2 or Elementary French E–4	30	30
Qualitative Analysis C–2	135	–
Stoichiometry C–3	15	–
Physical Education	30	30

For second-term subjects in Courses I, II and III, see pages 19, 21, 23.

Cotton Yarn Department

Course I.—Cotton Manufacturing.

The Cotton Manufacturing Course is designed for students contemplating a career in the manufacturing of cotton yarns and cloth or allied industries, and wishing to devote but three years to the school work.

During the first term the studies are common to all courses, and include instruction in mechanism, mathematics, mechanical drawing, textile design and elementary chemistry. Laboratory work supplements the lectures in chemistry, and weaving assists in illustrating the principles of textile design. At the commencement of the second term instruction in the preliminary processes of yarn manufacturing is given in the course of technology of fibers.

The work in the Cotton Yarn Department comprises instruction in all the manufacturing processes from the bale to the finished yarn. The instruction is given by means of lectures upon the machines and processes, and by laboratory work upon the machines themselves. In the laboratory each student is required to make exhaustive tests upon each machine, and to make as many settings and adjustments as possible. The third year's work in this department is largely devoted to lectures upon the manufacture of specialties, waste products, etc., and special laboratory work, special tests upon yarns and fabrics, mill planning with regard to the arrangement of machinery, and other work of an advanced nature.

The course in chemistry consists of lecture and laboratory work on inorganic and organic chemistry, followed by a lecture course of instruction in textile chemistry and dyeing.

The work in mechanism serves as a basis for all future machine and mechanical work, and is followed by steam engineering, electricity and mill engineering. The mechanical drawing taken in connection with these subjects augments this instruction as well as provides opportunity for students to become skilled in drafting.

The course in textile designing, cloth analysis and cloth construction includes lectures on plain and fancy weaves and Jacquard work, the analysis of all commercial fabrics, and designs for the same. During the third year of this course students in this department specialize on cotton fabrics.

Power weaving is taken up during the second and third years. Commencing with lectures and practice upon plain looms, the student is taken through dobby and box-loom weaving and Jacquards.

A course in knitting taken during the third year includes the manufacture of hosiery and underwear. The course on the finishing of cotton fabrics is given by lectures and laboratory work, and requires considerable work on standard machines in the laboratory.

For detailed description of the subject see page 30.

Course I.—Cotton Manufacturing.

[For first term see page 16.]

First Year. Second Term. (Hours of Exercise.)

Mechanism B–4	60	Elementary Chemistry C–1	75
Mechanical Drawing B–8	75	English E–1	45
Mathematics B–1	45	Physical Education	30
Textile Design D–1	135		
Technology of Fibers F–1, G–1, C–2	60		

Second Year. First Term.

Cotton Yarn Mfg. F–2	195	Machine Drawing B–10	30
Textile Design D–2	75	Steam Engineering B–12	45
Power Weaving D–9	90	Physics B–11	45
Chemistry and Dyeing Lect. C–5	30	Industrial History E–6	15

Second Year. Second Term.

Cotton Yarn Mfg. F–2	210	Steam Engineering B–14	15
Textile Design D–2	60	Machine Drawing B–10	45
Power Weaving D–9	120	Physics B–11	45
Chemistry and Dyeing Lect. C–5	15	Industrial History E–6	15

Third Year. First Term.

Cotton Yarn Mfg. F–2	195	Cotton Finishing H–2	75
Knitting F–3	60	Electricity B–20a	30
Textile Testing G–3	15	Mill Engineering B–22	30
Power Weaving D–10	120		

Third Year. Second Term.

Cotton Yarn Mfg. F–2	240	Cotton Finishing H–2	75
Knitting F–3	60	Textile Testing G–3	15
Power Weaving D–10	135	Thesis.	

Course II.— Wool Manufacturing.

The course on wool manufacturing is arranged for those who contemplate a career in the manufacture of woolen or worsted fabrics, and can devote but three years to the school work. It includes instruction on all of the varied processes employed in manipulating the wool fiber to produce yarn and cloth, namely, sorting, scouring, carding, combing, spinning, designing, weaving, dyeing and finishing. The work is carried on by lectures, recitations and practical work in the laboratories.

Following the first term of the first year, which is common to all courses, the student taking technology of fibers becomes acquainted not only with the various kinds of wool and trade terms applied to them, but also with other commercial fibers, viz., cotton, silk, jute, hemp, flax, etc., used in the textile industry. He is at the same time taught the application of these fibers and the general processes of manufacturing each into a yarn.

Beginning with the second year the details of manipulating wool from the grease to the finished yarn is taken up for close study. This includes the spinning of woolen yarn, also worsted yarn, by both the English and the French systems. The intermediate processes of sorting, scouring, carding, combing and top-manufacturing are taken in detail and in proper sequence.

The general chemistry of the first year is followed by a lecture course in the second year on textile chemistry and dyeing.

Textile design, cloth analysis and construction are continued from the first year throughout the course, the work being applied especially to woolen and worsted goods. Weaving on power looms commences in the second year and continues through the third.

Lectures on finishing commence with the third year and are augmented by extensive practice with the machines in the Finishing Department.

Work in the Engineering Department extends throughout all three years, and includes mechanical drawing, steam engineering and electricity. The practical application of the principles studied in these subjects is brought out forcibly in the work on mill engineering, where mill design and construction are considered. A short course covering methods employed in the testing of fibers, yarns and cloths, together with laboratory work in the manipulation of certain physical apparatus, is given in the third year.

For detailed description of the subjects see page 30.

Course II.—Wool Manufacturing.

[For first term see page 16.]

First Year. Second Term. (Hours of Exercise.)

Mechanism B-4	60	Elementary Chemistry C-1	75
Mechanical Drawing B-8	75	English E-1	45
Mathematics B-1	45	Physical Education	30
Textile Design D-1	135		
Technology of Fibers G-1, F-1, C-2	60		

Second Year. First Term.

Yarn Manufacture G-2	210	Machine Drawing B-10	30
Textile Design D-3	90	Steam Engineering B-12	45
Power Weaving D-9	60	Physics B-11	45
Chemistry and Dyeing Lect. C-5	30	Industrial History E-6	15

Second Year. Second Term.

Yarn Manufacture G-2	255	Steam Engineering B-14	15
Textile Design D-3	60	Machine Drawing B-10	45
Power Weaving D-9	75	Physics B-11	45
Chemistry and Dyeing Lect. C-5	15	Industrial History E-6	15

Third Year. First Term.

Yarn Manufacture G-2	195	Electricity B-20a	30
Knitting F-3	60	Mill Engineering B-22	30
Power Weaving D-10	120	Textile Testing G-3	15
Finishing H-1	75		

Third Year. Second Term.

Yarn Manufacture G-2	255	Power Weaving D-10	120
Knitting F-3	60	Finishing H-1	75
Textile Testing G-3	15	Thesis.	

Course III.—Textile Design.

The general course in textile design is planned to meet the demand of young men for a technical training in the general processes of textile manufacturing, but with particular reference to the design and construction of fabrics. To this end a foundation is laid in the first year by instruction in the elementary principles of designing, decorative art and weaving. That he may later in the course pursue to advantage instruction in yarn manufacturing, weaving, dyeing, finishing and some engineering problems, a foundation course in mechanics, mathematics and chemistry is laid. As the student is required to pursue courses in the yarn departments, both cotton and wool, he acquires a knowledge of the manufacture of cotton yarns from the bale to the yarn, and of woolen and worsted yarns from the fleece through the varied processes of manufacturing woolen yarn or worsted yarn by both the French and Bradford systems.

Throughout his entire course he receives instruction in design, cloth analysis and construction of all the standard cloths, viz., trouserings, coatings, suitings, blankets, velvets, corduroys, plushes, etc. This is followed by advanced work in Jacquard designing and weaving, which serves not only to acquaint the student with the many kinds of cotton, woolen, worsted and silk fabrics of figured design, but stimulates and develops any artistic talent he may possess. Decorative art becomes an important part of the work of the second and third years.

The course in general inorganic and organic chemistry of the first year leads to the subject of textile chemistry and dyeing in the second year.

Power weaving commences with the second year and continues throughout the course, and work on all types of looms is required.

During the third year the student receives instruction in the finishing of cotton goods and woolen and worsted cloths. This instruction is given by means of lecture and laboratory work.

The engineering subjects given in the second and third years are intended to acquaint the student with such general knowledge as will be of assistance should he be called upon in later life to be a mill manager, or should his subsequent progress lead to some executive position in the operation of a textile plant.

For detailed description of the subjects see page 30.

Course III.—Textile Design.

[For first term see page 16.]

FIRST YEAR. SECOND TERM. (HOURS OF EXERCISE.)

Mechanism B–4	60	Tech. of Fibers F–1, G–1 and C–2	60
Mechanical Drawing B–8	75	Elementary Chemistry C–1	75
Mathematics B–1	45	English E–1	45
Textile Design D–1	135	Physical Education	30

SECOND YEAR. FIRST TERM.

Design, Decorative Art D–1, 2, 3	150	Machine Drawing B–10	30
Cotton Yarn Mfg. F–1	150	Steam Engineering B–12	45
Power Weaving D–9	60	Physics B–11	45
Chemistry and Dyeing Lect. C–5	30	Industrial History E–6	15

SECOND YEAR. SECOND TERM.

Design, Decorative Art D–1, 2, 3	135	Wool Yarns G–2	105
Cotton Yarn Mfg. F–2	75	Steam Engineering B–14	15
Power Weaving D–9	75	Physics B–11	45
Chemistry and Dyeing Lect. C–5	15	Industrial History E–6	15
		Machine Drawing B–10	45

THIRD YEAR. FIRST TERM.

Design, Cloth Construction, Decorative Art D–6, 7, 8	120	Power Weaving D–10	75
Wool Yarns G–2	90	Wool Finishing H–1	75
Mill Engineering B–22	30	Cotton Finishing H–2	75
Knitting F–3	15	Electricity B–20a	30
		Textile Testing G–3	15

THIRD YEAR. SECOND TERM.

Design, Cloth Construction, Decorative Art D–6, 7, 8	180	Wool Finishing H–1	75
Wool Yarns G–2	90	Cotton Finishing H–2	75
Knitting F–3	15	Textile Testing G–3	15
Power Weaving D–10	75	Thesis.	

Course IV.—Chemistry and Textile Coloring.

The four-year Course in Chemistry and Textile Coloring, leading to the degree of B.T.C., is especially intended for those who wish to engage in any branch of textile chemistry, textile coloring, bleaching, finishing or the manufacture and sale of the dyestuffs or chemicals used in the textile industry. The theory and practice of all branches of dyeing, printing, bleaching, scouring and finishing are taught by lecture work supplemented by a large amount of experimental laboratory work and actual practice in the dyehouse and finishing room.

The underlying theories and principles of chemistry are the same, no matter to what industry the application is eventually made. Furthermore, no industry involves more advanced and varied applications of the science of chemistry than those of the manufacture and application of the coal-tar coloring matters. In addition, the textile colorist must consider the complex composition of the textile fibers, and the obscure reactions which take place between them and the other materials of the textile industry.

During the first year general chemistry, including both inorganic and organic, is taught by lectures and laboratory work, and this is supplemented during the second term by qualitative analysis and stoichiometry.

Advanced inorganic chemistry, as well as advanced organic chemistry, is studied during the second and third year as a continuation of the elementary chemistry of the first year, and much time is spent upon quantitative analysis, industrial chemistry, and textile chemistry and dyeing.

The foundation work in general chemistry is continued during the third year with courses in physical chemistry, organic laboratory work and analytical work. The subject of industrial chemistry is introduced, and much time is devoted to advanced textile chemistry, dye testing, color matching, calico printing and woolen, worsted and cotton finishing.

The fourth year is characterized by an endeavor to present certain subjects of a more applied nature in such a manner that the student's reasoning power and ability to apply the knowledge gained during the first three years may be developed to the fullest extent. The subject of engineering chemistry is introduced, and the work in the Dyeing and Analytical Laboratories is applied as far as possible to the actual requirements of the factory chemist and colorist. The student is given a thorough course in microscopy, photomicrography and the use of the various instruments, such as the spectroscope, ultra-microscope, polariscope, tintometer, etc., which often prove of vital importance in the advanced study of textile chemistry. During this fourth year the student devotes much time in the Organic Laboratory in the manufacture of dyestuffs. This is followed by some research work or original investigation as time will permit. Upon this he must present a satisfactory thesis, or report, before receiving his degree.

For detailed description of the subjects see page 30.

Course IV. — Chemistry and Textile Coloring.

[For first year see page 16.]

Second Year. First Term. (Hours of Exercise.)

Adv. Inorganic Chemistry C–7	30	Quantitative Analysis C–9	195
Textile Chemistry and Dyeing Lect. C–5	30	Steam Engineering B–12	45
Chemistry and Dyeing Lab. C–6	75	Physics B–11	45
Stoichiometry C–4	15	Industrial History E–6	15
		Advanced German E–3	30
		Mathematics B–2	45

Second Year. Second Term.

Adv. Inorganic Chemistry C–7	30	Quantitative Analysis C–9	150
Chemistry and Dyeing Lect. C–5	15	Adv. Organic Chemistry C–8	30
Chemistry and Dyeing Lab. C–6	135	Physics B–11	45
Stoichiometry C–4	15	Industrial History E–6	15
Mathematics B–2	45	Advanced German E–3	30
		Steam Engineering B–14	15

Third Year. First Term.

Adv. Textile Chemistry and Dyeing Lect. C–13	30	Adv. Organic Chemistry Lect. C–8	30
Adv. Textile Chemistry and Dyeing Lab. C–13	135	Technical German C–15	30
Industrial Chemistry C–12	30	Wool Finishing H–1	75
Quantitative Analysis C–10	165	Economics E–7	30

Third Year. Second Term.

Adv. Textile Chemistry and Dyeing Lect. C–13	15	Physical Chemistry C–11	30
Adv. Textile Chemistry and Dyeing Lab. C–13	75	Technical German C–15	30
Industrial Chemistry C–12	30	Organic Laboratory C–14	120
Wool Finishing H–1	75	Quantitative Analysis C–10	120
		Economics E–7	30

Fourth Year. First Term.

Physical Chemistry C–11	45	Quantitative Analysis C–21	15
Technical German C–15	30	Dyeing Laboratory C–13	135
Engineering Chemistry C–16	15	Organic Laboratory C–14	90
Adv. Textile Chemistry and Dyeing C–13	30	Industrial Laboratory C–17	45
Textile Testing G–3	15	Thesis C–22	105

Fourth Year. Second Term.

Physical Chemistry C–11	15	Adv. Dyeing Conference C–19	15
Organic Laboratory C–14	105	Technical German C–15	30
Microscopy C–18	45	Engineering Chemistry C–16	30
Dyeing Laboratory C–13	90	Thesis C–22	180
Textile Testing G–3	15		

Course VI. — Textile Engineering.

This course is the four-year general textile course leading to the degree of Bachelor of Textile Engineering (B.T.E.), and aims especially to fit men, in the broadest possible manner, to meet the increasing demands of every branch of the textile industry for men with combined textile and technical preparation. The magnitude and scope of the textile and allied industries fully justify the most thorough technical training possible for all who aspire to leadership in this field.

The student is first thoroughly grounded in those fundamental principles of science upon which all industrial and engineering work rests. The foundation of his textile and technical training is in the subjects of mathematics, physics, chemistry, drawing, mechanics, mechanism, and technology of fibers, and their practical application.

Instruction is given in all of the various branches of textile manufacturing through lectures, recitations and laboratory work. A large proportion of his time is spent in well-equipped textile departments where he studies and operates all of the machinery required in the conversion of cotton and wool fiber into yarns and fabrics. This includes cotton, wool and worsted yarn manufacturing, designing, weaving, knitting, dyeing and finishing. In his last year the course in textile testing acquaints the student with the methods for determining the physical properties of textile fibers, yarns and fabrics.

To properly equip the student to meet the varied engineering problems which confront the mill manager or executive, or to so train him that he may enter those industries closely allied to the textile instruction is given by lecture and laboratory practice in the several branches of engineering.

Steam engineering considers the problems involved in steam generation and distribution for power, heating and manufacturing purposes, includes the testing of laboratory and power plant equipment, and leads to the design of power plants. The course in electrical engineering includes a study of the generation and transmission of electrical power, the testing of direct and alternating current machinery, and is intended to acquaint the student with modern practice.

Mill engineering familiarizes the student with mill design, construction, heating, lighting, humidification and fire protection. The arrangement of machinery and buildings for most efficient production and economical power distribution is also studied in detail.

During the fourth year the student is required to conduct an original investigation of some textile or allied problem, and to submit the results in the form of a satisfactory thesis before receiving his degree.

The broadening effect of such subjects as English, language, industrial history and economics is carried still further in this course by carefully planned courses in business administration, accounting, cost accounting, business and patent law.

For the student who may desire the breadth of technical training which this course offers, but who wishes to specialize in either cotton or wool manufacturing, two options are offered. In these optional courses the student's entire textile time is devoted to the study of that particular fiber which he elects.

For detailed description of subjects, see page 30.

Course VI. — Textile Engineering (General Course.)

[For first year see page 16.]

Second Year. First Term. (Hours of Exercise.)

Chemistry and Dyeing Lect. C–13	30	Engineering Lab. B–16	45
Physics B–11	45	Cotton Yarn Mfg. F–1	45
Mathematics B–2	45	Wool Yarn Mfg. G–1	120
Machine Drawing B–10	75	Language E–3, 5	30
Steam Engineering B–12	45	Industrial History E–6	15
Power Weaving D–9	30		

Second Year. Second Term.

Physics B–11	45	Industrial History E–6	15
Mathematics B–2	45	Power Weaving D–9	30
Machine Drawing B–10	75	Chemistry and Dyeing Lect. C–13	15
Steam Engineering B–13	30	Graphic Statics B–5	30
Yarn Mfg. F–2 and G–2	165	Engineering Lab. B–16	45
Language E–3, 5	30		

Third Year. First Term.

Electrical Engineering B–20	75	Power Weaving D–10	45
Machine Shop Practice B–17	30	Mathematics B–2	30
Engineering Lab. B–16	45	Mill Engineering B–21	45
Cotton Yarn Mfg. F–2	60	Wool Finishing H–1	75
Wool Yarn Mfg. G–2	60	Economics E–7	30
Strength and Materials B–18	30		

Third Year. Second Term.

Hydraulics B–15	15	Wool Finishing H–1	75
Electrical Engineering B–20	75	Power Weaving D–10	45
Mill Engineering B–21	45	Mathematics B–2	30
Machine Shop Practice B–17	30	Strength of Materials B–18	30
Yarn Mfg. F–2 and G–2	150	Economics E–7	30

Fourth Year. First Term.

Cotton Yarn Manufacturing F–2	75	Power Plants B–19	30
Machine Shop Practice B–17	45	Business Administration B–24	45
Mill Engineering B–23	75	Elements of Accounting B–25	45
Electrical Engineering B–20	75	Thesis	75
Cotton Finishing H–2	30	Electives B–28	
Textile Testing G–3	15	Knitting F–3	15

Fourth Year. Second Term.

Yarn Mfg. and Knitting F–2, 3	30	Machine Shop Practice B–17	30
Mill Engineering B–23	75	Business Administration B–24	30
Electrical Engineering B–20	75	Cost Accounting B–26	45
Cotton Finishing H–2	75	Business Law B–27	15
Power Plants B–19	30	Thesis	105
Textile Testing G–3	15	Electives B–28	

Course VI. — Textile Engineering (Cotton Option.)

[For first year see page 16.]

Second Year. First Term. (Hours of Exercise.)

Chemistry and Dyeing Lect. C–13	30	Steam Engineering B–12	45
Physics B–11	45	Cotton Yarn Mfg. F–1	165
Mathematics B–2	45	Language E–3, 5	30
Machine Drawing B–10	75	Industrial History E–6	15
Engineering Lab. B–16	45	Power Weaving D–9	30

Second Year. Second Term.

Physics B–11	45	Power Weaving D–9	30
Mathematics B–2	45	Language E–3, 5	30
Machine Drawing B–10	75	Industrial History E–6	15
Steam Engineering B–13	30	Chemistry and Dyeing Lect. C–13	15
Yarn Mfg. F–2	165	Graphic Statics B–5	30
Engineering Lab. B–16	45		

Third Year. First Term.

Electrical Engineering B–20	75	Engineering Lab. B–16	45
Mill Engineering B–21	45	Mathematics B–2	30
Yarn Mfg. F–2	90	Strength of Materials B–18	30
Cotton Design D–6, 7	75	Economics E–7	30
Power Weaving D–10	30	Cotton Finishing H–2	75

Third Year. Second Term.

Hydraulics B–15	15	Power Weaving D–10	90
Electrical Engineering B–20	75	Mathematics B–2	30
Mill Engineering B–21	45	Strength of Materials B–18	30
Yarn Mfg. F–2	75	Economics E–7	30
Cotton Design D–6, 7	30	Cotton Finishing H–2	75
Machine Shop Practice B–17	30		

Fourth Year. First Term.

Machine Shop Practice B–17	30	Business Administration B–24	45
Mill Engineering B–23	45	Elements of Accounting B–25	45
Electrical Engineering B–20	75	Electives B–28.	
Yarn Mfg. F–2	75	Knitting F–3	60
Power Plants B–19	30	Thesis	75
Textile Testing G–3	15		
Textile Design D–7	30		

Fourth Year. Second Term.

Machine Shop Practice B–17	30	Cost Accounting B–26	45
Yarn Mfg. F–2	45	Business Law B–27	15
Mill Engineering B–23	75	Electives B–28.	
Electrical Engineering B–20	75	Knitting F–3	15
Power Plants B–19	30	Thesis	120
Business Administration B–24	30		
Textile Design D–7	30		

Course VI. — Textile Engineering (Wool Option.)

[For first year see page 16.]

Second Year. First Term. (Hours of Exercise.)

Chemistry and Dyeing Lect. C–13	30	Steam Engineering B–12	45
Physics B–11	45	Yarn Manufacture G–1	150
Mathematics B–2	45	Language E–3, 5	30
Machine Drawing B–10	90	Industrial History E–6	15
Engineering Lab. B–16	45	Power Weaving D–9	30

Second Year. Second Term.

Physics B–11	45	Power Weaving D–9	30
Mathematics B–2	45	Language E–3, 5	30
Machine Drawing B–10	75	Industrial History E–6	15
Steam Engineering B–13	30	Chemistry and Dyeing Lect. C–13	15
Yarn Manufacture G–2	165	Graphic Statics B–5	30
Engineering Lab. B–16	45		

Third Year. First Term.

Electrical Engineering B–20	75	Power Weaving D–10	45
Machine Shop Practice B–17	45	Engineering Lab. B–16	45
Mathematics B–2	30	Strength of Materials B–18	30
Mill Engineering B–21	45	Economics E–7	30
Yarn Manufacture G–2	105		
Woolen and Worsted Finishing H–1	75		

Third Year. Second Term.

Hydraulics B–15	15	Woolen and Worsted Finishing H–1	75
Electrical Engineering B–20	75	Power Weaving D–10	90
Mill Engineering B–21	45	Mathematics B–2	30
Machine Shop Practice B–17	30	Strength of Materials B–18	30
Economics E–7	30		
Yarn Manufacture G–2	105		

Fourth Year. First Term.

Machine Shop Practice B–17	30	Knitting F–3	15
Mill Engineering B–23	75	Textile Testing G–3	15
Electrical Engineering B–20	75	Business Administration B–24	45
Worsted Yarn Manufacture G–2	75	Elements of Accounting B–25	45
Woolen and Worsted Design, D–6, 7	45	Power Plants B–19	30
		Thesis	75

Fourth Year. Second Term.

Machine Shop Practice B–17	30	Cost Accounting B–26	45
Mill Engineering B–23	75	Business Law B–27	15
Electrical Engineering B–20	75	Power Plants B–19	30
Yarn Manufacture G–2	45	Thesis	135
Woolen and Worsted Design D–6, 7	30	Electives B–28	
Business Administration B–24	30	Knitting F–3	15

SUBJECTS OF INSTRUCTION.

TEXTILE ENGINEERING DEPARTMENT — B.

Mathematics — B–1. Preparation: Admission Requirements. The work in the first term consists of plane trigonometry, logarithms, and instruction in the use of the slide-rule. Right and oblique triangles are solved by means of natural and logarithmic functions, and the various algebraic relations among the trigonometric functions are proved and used in identities and equations. Significant figures and the use of approximate data in calculations are also discussed.

In the second term, the following topics are taken up: graphical and mathematical solution of quadratic and simultaneous equations, theory of equations, partial fractions, Naperian logarithms, equations of the straight line, and equations of various curves. [Courses IV and VI.]

Mathematics — B–1a. Preparation: Admission Requirements. This subject in the first term is identical with B–1, but excludes some of the topics given in the second term of B–1. [Courses I, II, III.]

Mathematics — B–2. Preparation: B–1. This subject is a continuation of the work of the first year course B–1, and extends throughout the second and third years of the engineering course. A study of the derivative is followed by the differentiation of algebraic functions and applications of the derivative to maximum and minimum and rate problems. Other topics treated are the circle, parabola, ellipse, hyperbola, indefinite integrals, summation by integration, areas, volumes and pressures.

In the following year, applications of calculus to mechanics are emphasized. The topics are as follows: integration by parts, integration by substitution, partial fractions, polar coordinates, centers of gravity, moments of inertia, radius of curvature, deflection of beams and empirical formulas. [Course VI.]

Mathematics — B–2a. Preparation: B–1. The work in this subject is similar to the first year of B–2 and is given for students of chemistry and textile coloring. [Course IV.]

Mechanics — B–3. Preparation: Admission Requirements. Taken simultaneously with B–1. This subject is required as a necessary preparation for all courses, and sixty hours of lecture and recitation time are devoted to it during the first term of the first year. The fundamental principles of this subject are considered absolutely essential to a thorough understanding of the operation of all machinery, textile or otherwise. Some of the topics treated in this course are linear and angular velocity, uniform and accelerated motion, mass, momentum, inertia, effect of force in producing motion, centrifugal force, work, power, energy, principle of moments and its applications, parallelogram and triangle of forces with applications, resolution and composition of forces, the mechanical principles represented by the wheel and axle, differential pulley block, common pulley blocks, jackscrew, worm and wheel, and inclined plane. [All courses.]

Mechanism — B–4. Preparation: B–1 and B–3. This subject is also deemed to be one of those absolutely essential to every student's preparation for the work of the following years, and sixty hours during the second term of the first year are allowed for it. Whereas the principles studied are of general application, textile machinery in particular furnishes an unusually large variety of specific examples, and frequent reference is made to these in the development of the course. Some of the important topics covered are gearing and gear train design, belting and pulley calculations, cone and stepped pulley design, cam design, linkages, epicyclic gear trains, and intermittent motion devices. [All courses.]

Graphic Statics — B–5. Preparation: B–1 and B–3. The work in this course is presented by lecture and recitations. First are considered mathematical and graphical conditions for equilibrium for any system of forces, and the subjects of center of gravity and funicular polygons are introduced. Then follow problems on bridge and roof trusses under various conditions of dead, live, wind and snow loading. [Course VI.]

Mechanical Laboratory — B–6. Preparation: B–1 and B–3. Taken simultaneously with B–4. This work is given during the second term of the first year, and is supplementary to the course in Mechanics and Mechanisms. Especial importance is attached to the demonstration of the fundamental principles of these

subjects. Some of the experiments and tests made in this course are as follows: —

Determination of coefficient of friction; proof of principle of moments; proof of principle of work; efficiency test of various hoisting and lifting appliances, such as tackle and fall, worm block, differential and triplex blocks, jackscrews, wedges, etc.; experimental proofs of the principles of graphic statics; efficiency tests on belt transmission, including measurement of belt tensions, coefficient of friction, slip, etc.

Tests on various types of absorption dynamometers; calibration of transmission dynamometer; power measurements on textile machinery with differential dynamometer; measurement of friction of steam engine. [Course VI.]

Mechanical Drawing — B–7. Preparation: Admission Requirements. Taken simultaneously with B–3. This course is taken during the first year, and consists of work in the drawing room supplemented by lectures. This subject is considered of the greatest importance as a preparation for the student's future work, and the practical usefulness of drawing of this character is fully emphasized. The course is systematically laid out covering in order the following divisions: —

Care and use of drawing instruments; geometrical constructions; elements of projections and descriptive geometry; isometric projection; developments with practical applications; sketching practice on machine details. [All courses.]

Machine Drawing — B–8. Preparation: B–7. This work is the continuation of Mechanical Drawing, and is pursued throughout the second term of the first year. This work is wholly of a practical character, and includes sketching from the textile machinery details, working scale detail and assembly drawing, tracing and blue printing. The rudiments of machine design to supplement the work in strength of materials is also given. [Courses I, II, III, VI.]

Machine Drawing — B–9. Preparation: B–7. For students electing the Chemistry and Textile Coloring course in the second term of the first year a course of machine drawing is given similar to B–8, except that it is not as extensive and is concluded in thirty hours. [Course IV.]

Machine Drawing — B–10. Preparation: B–4, B–7, B–8. During the second year the work in Machine Drawing is devoted to advanced graphical mechanism problems. The data for all of these problems are in every case taken directly from some of the textile machines that the students meet in other departments. These problems include cam designs for builder motions, mule scroll layouts, Scaife builder motion analysis, fly frame cone design, mule quadrant motion, analysis of camless winder, and a number of others of similar character. [Courses I, II, III, VI.]

Physics — B–11. Preparation: B–1 and B–3. This subject lays the foundation for later work in engineering and chemistry and also explains the general application of the laws and principles of physics. Instruction, consisting of lectures, demonstrations, and recitations, is given for three hours per week during the second year. The topics taken up the first term are:—thermometry, measurement of heat, change of state, expansion, transfer of heat, humidity, hydrostatics, elements of hydraulics, the vernier, kinetic energy, circular motion, harmonic motion, wave motion and sound.

The second term is devoted to the study of light, magnetism, and electricity. Some of the topics are: — nature and propagation of light, reflection and refraction lenses, the telescope and microscope, the spectroscope, color sensation, double refraction, magnetism, electrostatics, fundamental laws of direct currents, and electrolysis. [All courses.]

Steam Engineering — B–12. Preparation: B–1, B–3, B–4. The purpose of this course is to familiarize the student with the principles of elementary thermodynamics, the properties of steam, mechanical mixtures, combustion of fuels, types of boilers, and the auxiliaries of the modern boiler house. The course consists of forty-five exercises given in the first term of the second year. The lectures and recitations are supplemented with illustrative problems assigned for home preparation. [All courses.]

Steam Engineering — B–13. Preparation: B–12. This course is a continuation of B–12, and consists of thirty hours of lectures and recitations given in the second term of the second year of the Textile Engineering course. The subjects

developed are the kinematics of reciprocating steam engines, steam turbines and gas engines. Special attention is given to the mechanical principles on which the steam engine operates, with detail discussion of the valve gear and governing devices, and the various diagrams used for studying the same. Consideration is given to the underlying heat theory and to the details of construction of the various parts of the machines. During the latter part of the course the historical development, classification and types of turbines and gas engines are discussed. [Course VI.]

Steam Engineering — B-14. Preparation: B-12. This course consists of fifteen lectures and is supplementary to Course B-12. Its aim is to give those students who do not take the Engineering course a general knowledge of the steam engine, steam turbine and gas engine, and their auxiliaries. One exercise is devoted to an engine test to demonstrate the practical use of the indicator and the advantages of condensing. [Courses I, II, III, IV.]

Hydraulics — B-15. Preparation: B-2 and B-11. This subject is presented by means of lectures covering the principles of hydraulics, including hydrostatics, measurements of flow of water through orifices, pipes, nozzles and over weirs. The different types of turbines are studied with results of tests and rating tables. [Course VI.]

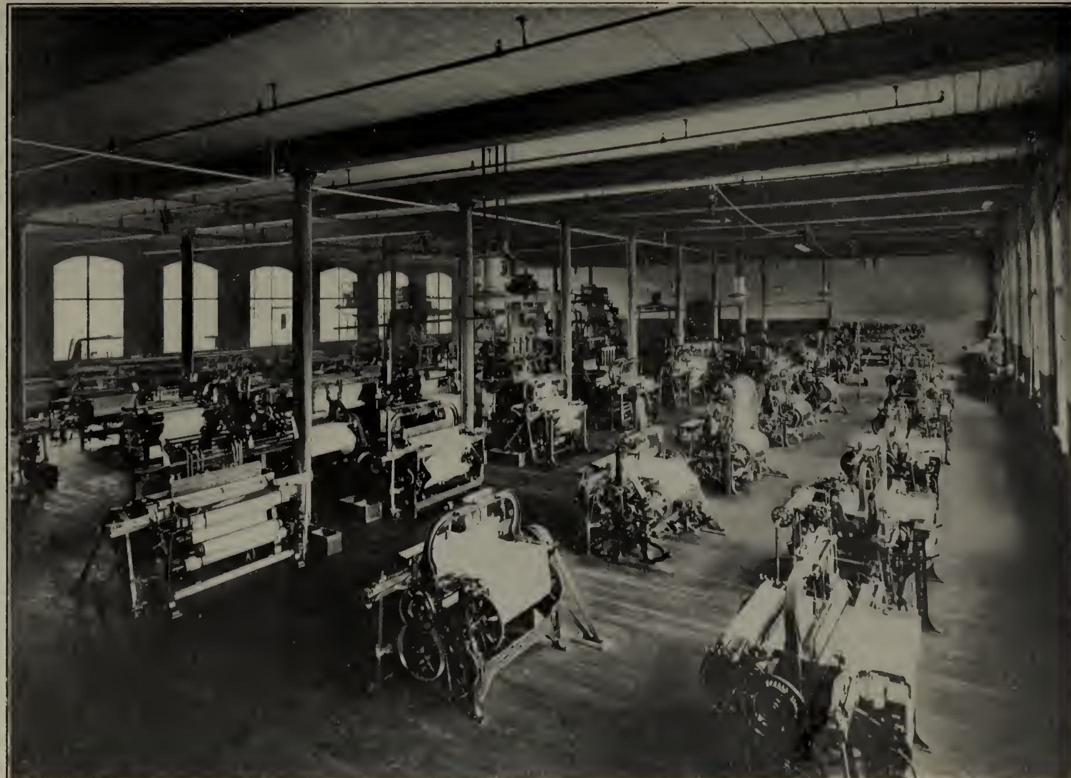
Engineering Laboratory — B-16. Preparation: B-12. The principles underlying the subjects of steam engineering, hydraulics and thermodynamics are demonstrated in a practical manner in the work in the Engineering Laboratory. Greater importance is attached to the development of iniative and responsibility in the student than the mere accomplishment of a large number of carefully planned tests. The character of this work is indicated by the following list of experiments and tests: —

Calibration of gauges, thermometers, indicators, anemometers, tachometers and other measuring instruments; experiments on flow of steam; calorimeter tests; radiation tests and pipe-covering tests; injector and ejector tests; engine tests, condensing and non-condensing; steam pump tests; surface condenser tests; valve setting; boiler testing; tests on heating and ventilating fans, both motor and engine driven; pump tests, triplex and centrifugal; air-compressor tests; flue gas analysis; steam turbine tests; condensing, non-condensing and low pressure; complete steam plant testing; gas engine testing. [Course VI.]

Machine Shop Practice — B-17. Preparation B-3 and B-4. Systematic instruction is given in the most approved methods of machine shop practice, the object being to familiarize the student with the proper use of hand and machine tools, and the characteristics of the different materials worked. Particular attention is given to the form, setting, grinding and tempering of tools and the mechanism of the different machines involving certain speeds, feeds, etc. The course is so planned that the instruction in each typical operation shall conform as nearly as possible to commercial machine-shop practice on textile machinery. The list of tools which appears under "Equipment" in this Bulletin gives an idea of the scope of the work, which includes chipping and filing, tool grinding and tempering, straight and taper turning, screw cutting, drilling and boring, planer work; milling machine work, including gear cutting. Instruction is also given in the use of woodworking tools, both hand and machine, and in forging. [Course VI.]

Strength of Materials — B-18. Preparation: B-2, B-4, B-5. This subject consists of sixty exercises given in the third year of the Textile Engineering course, and in which are discussed, as fully as time permits, such topics as stress, strain, methods of testing materials, bending moments, shearing force, beam design, column design, torsion, design of shafts, compound beams and columns, combined stresses, etc. The subject is preparatory to the work in Mill Engineering of both the third and fourth years, where its practical value and application are clearly demonstrated. [Course VI.]

Power Plants — B-19. Preparation: B-13. This course, which consists of lectures given during the fourth year, takes up the fundamental consideration involved in the planning of a power plant for a textile mill. A standard textbook is used in connection with the lectures, and the problems are taken largely from plans of existing modern plants. The choice of type and size of units for certain conditions are given particular attention. [Course VI.]



Weave Room

Electrical Engineering — B–20. Preparation: B–11. The elementary principles of electricity and magnetism are considered in the lecture course of physics. Their development and application are taken up in this course in detailed study of the means used to generate, transmit and transform electrical energy to meet the requirements of textile machinery and plants. This involves the theory of direct and alternating current generators, motors, instruments, as well as the various phenomena associated with them.

The laboratory course includes a study of instruments and methods employed in general electrical power testing. Attention is given to various lighting units, their particular properties and relative values in meeting the special problems of illumination in textile mills. [Course VI.]

Electricity — B–20a. Preparation: B–11. This is a short course given in the third year of the manufacturing courses, and consists of thirty lectures covering briefly and in a general way the theory of direct and alternating current generators and motors. [Courses I, II, III.]

Mill Engineering — B–21. Preparation: B–2, B–4, B–5, B–10, B–18. Mill Engineering, as presented in thirty lectures during the third year of the Textile Engineering course, consists of a discussion of the following topics: the selection of a site for a manufacturing plant; the exploration of the subsoils for the footing course of the foundation; wood, concrete and sheet steel piling; design of walls columns, beams, floors, windows, doors, stairways and roofs.

Sixty hours of drawing room and laboratory practice are devoted to plane surveying, contour plotting, cut and fill calculations, setting of batter boards, alignment of shafting and the study from blue prints of slow-burning construction. [Course VI.]

Mill Engineering — B–22. Preparation: B–1, B–4, B–10. Mill Engineering, as presented in thirty lectures during the third year of the diploma courses, is largely general in its nature and includes only parts of Course B–21. [Courses I, II, III.]

Mill Engineering — B–23. Preparation: B–3, B–4, B–10, B–17. This work, given in the fourth year of the Textile Engineering course, covers a wide range of subjects and is of the most practical character possible. All of the student's previous work in engineering and his knowledge of the textile processes are here brought together in the consideration of the larger problems of mill design, construction and organization. After a detailed study has been made of the most modern types of mill buildings, including all calculations and drawings, the student is given the problem of laying out and completely designing a textile mill so far as time permits.

The modern methods of power transmission and the proper arrangement of textile machinery are also given careful consideration. The problems are in every case taken from actual conditions in mills already built or in process of construction. The question of mill heating, ventilation, lighting, humidification and fire protection is also studied, and the time spent in the drawing room enables the student to work out nearly all of the more important problems involved in the design of an entire textile mill plant. The close relation existing between proper plant design and economical production is also considered. [Course VI.]

Business Administration — B–24. Preparation: B–1 and E–7. In recognition of the great advances which have been recently made towards better methods of management, and of the possibilities which may result from its application to the textile industry, a course in business administration has been established to enable the student to understand and apply the principles and details of modern management. The instruction in this course begins with a consideration of the factory location and design and their effect on efficiency of production, after which the proper form of organization for manufacturing establishments is discussed in detail, together with organization charts and records.

This is followed by a study of the details of the work of the various departments, such as purchasing, manufacturing, planning, etc., and includes such topics as purchasing systems, storeskeeping, perpetual inventories, warehousing, scheduling, routing, tracing, timekeeping, motion studies, time studies, mnemonic symbolizing, graphical records, wage systems, etc. Consideration is also given to the important relation of psychology to efficient management. The work is further supplemented

by visits to plants where methods of production and management can be observed at first hand by the students. [Course VI.]

Elements of Accounting — B–25. Preparation: B–1 and E–7. The purpose of the course in accounting is to acquaint the student with modern methods of accounting for mercantile and manufacturing businesses. At the same time it gives him a much-needed knowledge of such common elementary business transactions as are involved in the use of checks, drafts, notes, vouchers, bonds and stocks.

It is not the purpose of the course to make the student a proficient bookkeeper or accountant, but the nature of the work necessitates a basic knowledge of double-entry bookkeeping and of the functions of ledger accounts. This is developed in practice in the following manner: During the summer preceding the fourth year the student is required to work up a simple bookkeeping set, thus saving valuable time during the school year and effectively preparing the ground for the instruction work.

The course includes a study of the balance sheet and profit and loss statement, and their construction in proper form. Attention is given to the principles of balance sheet valuation, and to such topics as depreciation in all its phases, sinking fund reserves, and the accounting for bond and stock issues. [Course VI.]

Cost Accounting — B–26. Preparation: B–25. The major portion of the time scheduled for accounting in the second term of the fourth year of the Textile Engineering course is devoted to a study of this important topic. It is designed to give the student a knowledge of the various cost methods in use at the present time, and involves a thorough discussion of methods of handling and accounting for raw materials, direct labor, and the distributiom of overhead expenses. To supplement the instruction, the student is required to work up a cost accounting set. [Course VI.]

Business Law — B–27. Preparation: E–7. Under this subject are given lectures, supplemented by the use of a suitable text, on the law governing contracts, negotiable instruments, sales, bills of lading, real estate and corporation. [Course VI.]

Electives — B–28. Students in the fourth year of the Textile Engineering course will be permitted to elect certain textile subjects as substitutes for part of the time scheduled for engineering subjects. Thus a student is offered an opportunity for specialized study along such lines as will prove most beneficial to him at that time. The selection of elective studies is subject to the approval of the head of the Textile Engineering department and to the possibility of arranging for the same. [Course VI.]

CHEMISTRY AND DYEING DEPARTMENT — C.

Elementary Chemistry (Inorganic and Organic Chemistry) — C–1. Preparation: Admission Requirements. Instruction in Elementary Chemistry extends through the first year, and includes lectures, recitations and a large amount of individual laboratory work upon the following subjects: —

Chemical Philosophy. — Chemical action, chemical combination, combining weights, atomic weights, chemical equations, acids, bases, salts, Avogadro's law, molecular weights, formula, valence, periodic law, etc.

Non-metallic Elements. — Study of their occurrence, properties, preparations, chemical compounds, etc.

Metallic Elements. — Study of their occurrence, properties, metallurgy, chemical compounds, etc.

The students take up, as thoroughly as time will permit, the qualitative detection of the more common metals and non-metals, with practical work.

The Hydrocarbons and their Derivatives. — Study of their occurrence, properties, preparations and uses. This work, although elementary in character, is of sufficient breadth to prepare the student understandingly for the work with artificial dyestuffs which follows. [All courses.]

Chemistry Technology of Fibers — C–2.

The outline of the lecture course which is given during the second term of the first year is as follows: —

Technology of Vegetable Fibers. — Cotton, linen, jute, hemp, china grass. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Animal Fibers. — Wool, mohair, silk. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Artificial Fibers. — Study of the various forms of artificial silk, the process of manufacture, their properties and action with chemicals, acids and heat. [All courses.]

Qualitative Analysis — C–3. Preparation: C–1 taken simultaneously. Qualitative Analysis is studied during the second term of the first year. The work consists of lectures, recitations and laboratory work. The student must become familiar with the separations and the detections of the common metals and acids by the analysis of a satisfactory number of solutions, salts, alloys and pigments. At intervals during the term short laboratory tests are given as well as the regular written examinations.

No pains are spared to make the course as valuable to the student as possible, and to encourage only thorough and intelligent work.

When sufficiently advanced, students take up the examination of various products with which the textile chemist must be familiar such as testing mordanted cloths, pigments and the various dyeing reagents.

During the latter part of this course a certain amount of time is devoted to the preliminary operations of quantitative analysis, such as the precipitation and washing of such substances as barium sulphate, magnesium ammonium phosphate and calcium oxalate, although no weighings or actual determinations are made.

A student's marks in this subject depend as much upon the neatness and care used in manipulation as upon the actual results obtained. [Course IV.]

Stoichiometry — C–4. Preparation: B–1, C–1. This subject is taken during the second half of the first year, and is continued throughout the second year as an adjunct to Quantitative Analysis. The application of the metric system is thoroughly studied, and problems are worked involving the expansion and contraction of gases, determination of empirical formulæ, combining volume of gases and quantitative analysis. [Course IV.]

Textile Chemistry and Dyeing — C–5. Preparation: C–1, B–4, B–7.

Operations Preliminary to Dyeing. — Bleaching of cotton and linen; wool-scouring; bleaching, fulling and felting of wool; carbonizing; silk-scouring and bleaching; action of soap.

The bleaching of cotton cloth, yarn and raw stock is studied at length with detailed description of the various forms of kiers and machinery used; also the action of the chemicals used upon the material, and the various precautions that must be taken in order to insure successful work.

Under this heading is also included an exhaustive study of the reagents used in the emulsive wool-scouring process, and their action upon the fiber under various conditions; also the most successful of the solvent methods for degreasing wool.

Water and its Application in the Textile Industry. — Impurities present, methods for detection, their effect during the different operations of bleaching, scouring, dyeing and printing, and the methods used for their removal or correction.

The important subject of boiler waters is also studied under this heading, with a full discussion of the formation of boiler scale, its disastrous results, and the methods by which it may be prevented.

Mordants and Other Chemical Compounds used in Textile Coloring and Classified as Dyestuffs. — Theory of mordants, their chemical properties and application, aluminum mordants, iron mordants, tin mordants, chromium mordants, organic mordants, tannin materials, soluble oil, fixing agents, leveling agents, assistants, and numerous other compounds, not dyestuffs, that are extensively used in the textile industry.

Under this heading are included the definitions of various terms and classes of compounds used by textile colorists, such as color lakes, pigments, fixing agents, developing agents, mordanting assistants, mordanting principles and leveling agents.

Theory of Dyeing. — A discussion of the chemical, mechanical, solution and absorption theories, and the various views that have been advanced by different investigators of the chemistry and physics of textile coloring processes.

Under this heading are discussed the general methods of classifying dyestuffs and the definitions of such terms as textile coloring, dyeing, textile printing, substantive and adjective dyestuffs, monogenetic and polygenetic dyestuffs.

Natural Organic Coloring Matters. — Properties and application of indigo, logwood, catechu, or cutch, Brazil wood, cochineal, fustic, tumeric, madder, quercitron bark, Persian berries, and other natural dyestuffs that have been used within recent years by textile colorists.

Mineral Coloring Matters. — Under this heading are discussed the properties of such inorganic coloring matters and pigments as chrome yellow, orange and green, Prussian blue, manganese brown, and iron buff.

Artificial Coloring Matters. — General discussion of their history, nature, source, methods of manufacture, methods of classification and their application to all fibers.

Special study of basic coloring matters, phthalic anhydride colors, including the eosins and phloxines; acid dysetuffs, Janus, direct cotton, sulphur and mordant colors, including the alizarines and other artificial coloring matter requiring metallic mordants; mordant acid and insoluble azo colors, developed on the fiber; reduction vat colors, aniline black and other artificial dyestuffs not coming under the above heads.

As each class of dyestuffs is taken up, the details of the methods of applying them upon all the different classes of fabrics and in all the different forms of dyeing machines are thoroughly discussed; also the difficulties which may arise in their application, and the methods adopted for overcoming them.

Machinery used in Dyeing. — A certain amount of time is devoted to the description of the machinery used in various processes of textile coloring which is supplemented as far as possible by the use of charts, diagrams and lantern slides.

Most of the important types of dyeing machines are installed within the dyehouse of the school, and the students can be taken directly from the lecture room and shown the machines in actual operation. [All courses.]

Dyeing Laboratory — C–6. Preparation: C–5 taken simultaneously. Besides lectures and recitations upon the subject of Textile Chemistry and Dyeing, practical laboratory work is required. By the performance of careful and systematic experiments the student learns the nature of the various dyestuffs and mordants, their coloring properties, their action under various circumstances, and the conditions under which they give the best results. The more representative dyestuffs of each class are applied to cotton, wool and silk, and each student is obliged to enter, in an especially arranged sample book, a specimen of each of his dye trials with full particulars as to the conditions of experiment, percentage of compounds used, time, temperature of dye bath, etc.

For convenience and economy most of the dye trials are made upon small skeins or swatches of the required materials, but from time to time students are required to dye larger quantities in the full-sized dyeing machines which are described elsewhere.

By the use of a small printing machine the principles of calico printing are illustrated, and by means of the full-sized dyeing machines and vats the practical side of the subject is studied. It is the constant endeavor of those in charge to impart information of a theoretical and scientific character that will be of value in the operation of a dyehouse. [Course IV.]

Advanced Inorganic Chemistry — C–7. Preparation: C–1. The whole subject of Inorganic Chemistry is reviewed during the second year, and many advanced topics are introduced which were necessarily omitted from the first-year course in General Chemistry. [Course IV.]

Advanced Organic Chemistry — C–8. Preparation: C–1. In this course, which consists of lectures and recitations, the principles of organic substitution and synthesis are thoroughly discussed, and as many illustrations are used as time will permit, particularly such as are applied in the arts. The aliphatic series of hydrocarbons and their derivatives are studied for about twenty weeks, the remainder of the time being devoted to the benzine series. The aim of the course

is to lay a broad foundation for the study of the chemistry of the artificial dyestuffs. Students are required to work out problems in the synthesis of various compounds, in order to become familiarized with equation writing. [Course IV.]

Quantitative Analysis — C–9. Preparation: C–3, C–4. The object of this course is to teach the fundamental principles of quantitative analysis, and to give the student an opportunity of acquiring skill in manipulating the special apparatus used in analytical procedure.

Typical gravimetric methods are taught the first term, The samples analyzed comprise salts, minerals, and ores. Electro-chemical analysis is carried out with the aid of a modern type of apparatus designed for rapid work.

The work of the second term consists of volumetric methods. A number of ores and commercial products, carefully chosen, are analyzed so as to give the student a varied experience.

The laboratory work is supplemented by lectures and recitations. Smith's "Quantitative Chemical Analysis" is used as a text. [Course IV.]

Quantitative Analysis — C–10. Preparation: C–9. The fundamental principles acquired in course C–9 are applied in this course in the examination of materials used in the textile mill, the dye house, and the finishing plant. Among the materials analyzed are water, soaps, oils, textile fabrics, stripping agents, acids and alkalies. The latest and most practical methods are employed. Griffin's "Methods of Technical Analysis" is used as a text. [Course IV.]

Physical Chemistry — C–11. Preparation: C–7, C–8, B–11. This subject is studied during the third and fourth years. It includes the principles of calorimetry, specific heat, vapor density, the various methods of determining molecular weights, laws of solutions, electrolytic dissociation, theories of precipitation, thermo-chemistry, surface tension, etc. The student is required to work out a large number of problems introduced by the subject. [Course IV.]

Industrial Chemistry (Lecture) — C–12. Preparation: C–7, C–8. During the whole of the third year lectures and recitations are held in industrial chemistry, the course in general following Rogers' "Manual of Industrial Chemistry." Particular attention is paid to those subjects which are of special interest to the textile chemist, as oils, soaps, gas and coal-tar industry, building materials, and the manufacture on a large scale of important chemical compounds, such as the common acids and alkalies, bleaching powders, various mordants, etc. The course is illustrated as far as possible with specimens, diagrams and charts, and the students are given an opportunity to visit some of the industrial establishments in the vicinity of Lowell and Boston. [Course IV.]

Advanced Textile Chemistry and Dyeing — C–13. Preparation: C–5, C–6. This is a continuation of the Textile Chemistry and Dyeing Course of the second year, and includes a review of the second year's work in this subject, with the introduction of many advanced considerations, and, in addition, the following subjects: —

Classification and Construction of Artificial Dyestuffs. — A study from a more advanced standpoint of the classification and constitution of artificial dyestuffs including the various methods used in their production, also the orientation of the various groups which are characteristic of these compounds, and their effect on the tinctorial power of dyestuffs.

The object of this study is to give the student a more complete knowledge of the artificial dyestuffs from the color manufacturer's point of view, which will prove of particular value to those who intend later to enter the employ of dyestuff manufacturers or dealers.

Color Matching and Color Combining. — A study of that portion of physics which deals with color and the many color phenomena of interest to the textile colorist. The lecture work is supplemented with the practical application of the spectroscope and tintometer, and much practice in the matching of dyed samples of textile material.

The primary colors both of the scientist and textile colorist, the results of combining coloring lights and pigments, and such subjects as color perception, color contrast, purity of color, luminosity, hue, color blindness, dichroism, fluorescence, and the effect of different kinds upon dyed fabrics, are discussed under this heading.

Each student's eyes are tested for color blindness early in the course, in order that he may be given an opportunity to change his course if his eyes should prove defective enough to interfere with his work as a textile colorist.

A dark room has been provided where various experiments in color work and color matching may be performed.

Dye Testing. — This subject includes the testing of several dyestuffs of each class, subjecting them to the common, color-destroying agencies; the determining of their characteristic properties, and their action towards the different fibers; also the determining of the actual money value and coloring power of dyestuffs in terms of a known standard.

Each student is required to make a record of each color tested upon an especially prepared card, which furnishes a permanent record of all dyestuffs, their dyeing properties, fastness to light and weather, washing, soaping, fulling, perspiration, bleaching, steaming, ironing, rubbing, acids and alkalies.

Union Dyeing. — A study of the principles involved in the dyeing of cotton and wool, cotton and silk, and silk and wool union materials in the production of solid and two-color effects.

Textile Printing. — A thorough study of the whole subject of textile printing, each student being required to produce individually no less than twenty different prints, including the following styles: pigment style, direct printing style, steam style with tannin mordant, steam style with metallic mordant, madder or dyed style, the ingrain or developed azo style, discharge dye style, discharge mordanted style, resist style, indigo printing, aniline black printing.

The different parts of the calico printing machine are thoroughly studied; also the precautions which must be considered in its use, and the arrangement of the dyeing apparatus which must accompany such a machine.

Special attention is paid to the methods of mixing and preparing the various color printing pastes that are used in the above work upon a manufacturing scale as well as experimentally in the laboratory.

Cotton Finishing. — A study of the various processes of finishing cotton cloth and the different materials used therein. The work involves the discussion of the various objects of cotton finishing and such operations as pasting, damping, calendering, stretching, stiffening, mercerizing, beetling and filling, and the various machines used for carrying out these processes.

Mill Visits. — During the third and fourth years visits are made to some of the large dyehouses, bleacheries and printworks in the vicinity. [Course IV.]

Organic Chemistry Laboratory — C–14. Preparation: C–5, C–7, C–8, C–9. This course, while including practice in the usual methods of organic analysis, and giving excellent training in the principles and manipulations of general organic synthesis, is especially devoted to the synthetic dyestuffs. The student not only prepares many of the representative dyestuffs, but, what is far more important, he carries out all the operations, beginning with coal tar itself. Thus,. instead of merely coupling two or more of the foreign imported intermediate products to make a dysetuff, he starts with the basic substances obtained from the coal tar, and makes his own intermediate products. As far as is possible the student will be made acquainted with the problems which might arise in a dyestuff factory, and an excellent opportunity is presented for original work. [Course IV.]

Technical German — C–15. Preparation: E–3, C–5, C–7, C–8. This course consists of the reading of German technical literature, with the object of familiarizing the student with the current German publications in textile chemistry and coloring. [Course IV.]

Engineering Chemistry — C–16. Preparation: C–7, C–8, C–9. A series of lectures is given upon the general subject of Engineering Chemistry, which include particularly the consideration of fuels, oils and water from the chemical engineer's standpoint. The elements of chemical engineering are also considered to such an extent as time will permit. [Course IV.]

Industrial Analysis — C–17. Preparation: C–9. In conjunction with the lectures in engineering chemistry there is required a specified amount of laboratory work in the Industrial Analysis Laboratory, which has been recently thoroughly equipped with the latest and best apparatus for fuel and oil analysis. [Course IV.]

Microscopy and Photomicrography — C—18. Preparation: B-11, C-5, C-7, C-8, C-9. The value of the microscope in the detection and examination of the various fibers cannot be overestimated, and often facts may be discovered, and conclusions drawn, which could be arrived at in no other way.

The students in this course are given as much work with the microscope as time will permit. They receive instruction in the use of the high-grade microscopes, and not only have practice in the examination and detection of the fibers, but are required to become proficient in the preparation of permanent slides.

Opportunity is also given for students to take photomicrographs of fibers and the various slides which they may prepare. A special dark room has been provided for this purpose. [Course IV.]

Advanced Dyeing Conference — C-19. Preparation: C-5. During the latter part of his course each student will be required to write, for presentation before the other members of his class, a paper upon some assigned subject of general interest. After presentation the subject will be open to discussion and question.

The object of this conference is twofold. First, to give the student experience and practice in systematically looking up an assigned subject, and presenting it before others; and secondly, to bring before the class a greater variety of subjects with more detail than could be covered by the general lectures of the course. [Course IV.]

Advanced Organic Chemistry (Dyestuffs) — C-20. Preparation: C-14. This course consists of an advanced study of the coal-tar coloring matters, their chemistry, relations of their composition to their coloring power, and the chemistry of their preparation. [Course IV.]

Quantitative Analysis — C-21. Preparation: C-10. This course consists of lectures, recitations and quizzes on the theory of analytical procedure, and the sampling of materials. [Course IV.]

Thesis — C-22. Before graduation the student must present a thesis which shall consist of a report of some original investigation or research that he has conducted while at the school.

A relatively large number of hours are specially set aside for this work, and students are encouraged to select some object for their investigation which shall be of practical as well as theoretical interest. [Course IV.]

TEXTILE DESIGN AND WEAVING DEPARTMENT — D.

Textile Design — D-1. During the first year instruction is given in the subject of classification of fabrics, use of point or design paper, plain fabrics, intersection, twills and their derivation, sateen, basket and rib weaves, checks and stripes, fancy weaves, including figured and colored effects; producing chain and draw from design, and *vice versa;* extending and extracting weaves. [First term, all courses.] [Second term, Courses, I, II, III, VI.]

Decorative Art — D-1. The instruction in this subject commences with the second year for students taking the Design course. During the first term freehand drawing is taught by means of plates, and practice in coloring is given in conjunction with this work.

Practice, in lettering, spacing and general arrangement of designs and sketches is given. The engineering alphabet is used in all work.

During the second term instruction is given in drawing, sketching, coloring and designing, with reference to their application in textiles. Good examples of applied design in textiles, as well as in other branches, are used as a basis for modified designs selected and composed by the student. This stimulates originality as well as teaches the student to appreciate good designs and color. [Course III.]

Cloth Analysis — D-1. In the first year this subject takes up in a systematic manner the analysis of samples illustrating the various cloth constructions for the purpose of determining the design of the weave and the amount and kind of yarns used, and forms the basis of calculation in the cost of reproducing any style of goods. The various topics discussed are reeds and setts; relation and determination of counts of cotton, woolen, worsted, silk, and yarns made from the great variety of vegetable fibers; grading of yarns, folded, ply, novelty and fancy yarns; application of the metric system to yarn calculation; problems involving take-up,

average counts, determination of counts of yarn, and weight of yarn required to produce a given fabric. [First year, all courses.]

Textile Design — D–2. For Cotton Goods — Preparation: D–1. During the second year consideration is given to fancy and reverse twills, diaper work, damasks, skip weaves, sateen fabrics with plain ground, backed fabrics, and multiple ply fabrics. Students are required to make original designs and put the same into the loom. Special attention is given to the consideration of color effect.

The analysis of these fabrics forms a part of the course in design. This also includes the necessary calculations required to reproduce the fabric or to construct fabrics of similar character. [Courses I, III, VI.]

Textile Design — D–3. For Woolen and Worsted Goods — Preparation: D–1. During the second year the instruction given includes warp and filling backed cloth, figured effects produced by extra warp and filling, double cloths, multiple ply fabrics, cotton warps, blankets, bath robes, crêpes, filling reversible, Bedford cords, imitation furs, crépons, matelasse and imitations, double plain, ingrains, velvets, corduroys, overcoatings, trouserings.

The analysis of these fabrics, together with the consideration of the shrinkages and dead loss in all fabrics, theory of diameter of yarns, and costs of mixer blends, is a part of this course. [Courses II, III, VI.]

Textile Design — D–6. Preparation: D–2 or D–3. The advanced work takes up the more complicated weaves adapted to harness work, and leads into leno and Jacquard designs. The following is a brief list of the subject heads, which will give some idea of the course: double plain cloths, ingrains, tricots, chinchilla, tapestry, blankets, upholsteries, spot weaves, pile or plush, crépon, matelasse and its imitations, piqué, Marseilles, quilting, and miscellaneous designs for Jacquard, leno, fustian, tissue fabrics and lappets. [Courses I, II, III, VI.]

Cloth Construction — D–7. Preparation: D–2 or D–3. The work includes the application of the different weaves and their combinations in the productions of fancy designs, both modified and original; the calculation involved in the reproduction of standard fabrics changed to meet varying conditions of weight, stock, counts of yarn and value; and the discussion of the breaking strength of fabrics and relationship of the construction of the fabric to breaking strength.

Instruction in this subject, which is given by classroom work, is intended to bring together the principles considered under the subject of design, cloth construction, weaving and yarn making of previous years, and to show the bearing each has in the successful construction of a fabric. [Courses I, II, III, VI.]

Decorative Art — D–8. Preparation: D–4. Original designs and sketches for particular grades of goods and the study of color effects form the important part of the second and third-year courses. It should be understood that work in decorative art is carried on in conjunction with textile construction and weaving, particularly on the Jacquard loom. Designs of merit are carefully developed in detail and woven into cloth. [Course III.]

Decorative Art for Special Students. — This course is planned to give a student a working knowledge and appreciation of design. The first and second years are devoted to a general study of design, color, perspective, lettering and rendering. Drawings are made in the historic styles for all materials, — wood, gold, silver, copper, brass, leather, fabrics, wall papers and glass.

In the third year students should specialize and devote their attention to the material in which they expect to work.

Power Weaving — D–9. Preparation: D–1. In connection with the work in Textile Design and Cloth Analysis practical work is carried on upon the power looms. This includes the preparation of warps, beaming, dressing, sizing, drawing-in and making of chains, the cutting and lacing of cards, spooling and quilling and the machinery for the same. A study is made of warpers and sizing machines, both for cotton and woolen. Lectures are given to correspond with the progress of the student in the Power Weaving Laboratory covering the following subjects: loom adjustments, chain building, shuttle changing looms, dobby looms, single and double acting dobbies, handkerchief motions, leno weaving, center selvedge motion, filling changing looms, oscillating reeds, lappet motions, various shaker motions, towel and other pile cloth weaving, Jacquard looms, single and double lift leno

Jacquards, Jacquards of special design, tying up Jacquard harness. [Courses I, II, III, VI.]

Power Weaving — D–10. Preparation: D–9, D–2, or D–3. Instruction is given in weaving on fancy woolen and worsted looms, single and double acting dobbies, leno weaving, various shaker motions, lappet loom weaving, double and single lift Jacquard looms, tying up Jacquard harness, leno Jacquard, harness and box chain building; warp preparation for woolen and worsted and cotton; formulas for making up different kinds of sizing. Lectures are given to correspond with the same. [Courses I, II, III, VI.]

LANGUAGE AND HISTORY DEPARTMENT — E.

English — E–1. Preparation: Admission Requirements. A technically trained man should be able to express himself clearly, forcibly and fluently, as inability to do so will be a serious handicap to him in after life. The object of the English course is to develop the student's power of expression by a thorough study of the principles of advanced rhetoric and composition, and by constant writing of themes illustrative of the four forms of discourse, viz., description, narration, exposition and argumentation. In addition to the study of rhetoric and composition and the writing of themes, several classics such as are not read in the preparatory schools are studied and discussed. [All courses.]

Elementary German — E–2. Preparation: Admission Requirements. This course is intended for first-year students who do not offer German as an entrance requirement and who desire to take the course in chemistry and Textile coloring. It may be selected by students taking the Textile Engineering course who have not fully met the entrance requirements in language. The work is elementary in character, and much time is devoted to the study of the rudiments of German grammar with practice in composition. During the latter part of the year considerable attention is given to the reading of ordinary German prose, which serves as an additional preparation to the student for the later reading of works along scientific and industrial lines.

Advanced German — E–3. Preparation: E–2. For students who are pursuing a degree course the elementary course of the first year is continued throughout the second year. The work consists of the study of some of the more advanced principles of grammar, and especially of the reading of scientific German dealing with a variety of subjects, and the translation of commerical German. [Courses IV, VI.]

Elementary French — E–4. Preparation: Entrance Requirements. This course is intended for first-year students, who elect the Textile Engineering course and who have had two years' work in this subject. Facility in translation is acquired by a considerable amount of reading from general or scientific sources.

Advanced French — E–5. Preparation: E–4. For students who are pursuing the Textile Engineering course and offer two years' preparatory school work in French, a course in translation of scientific French is required during the second year. [Course VI.]

Industrial History — E–6. Preparation: Admission Requirements. The economic history of a nation is not less interesting or dramatic than its political history, while it is absolutely essential to a thorough understanding of modern business conditions. The object of this course, which is intended for second-year students, is to trace the development of the three leading industrial nations of the world, viz., the United States, England and Germany, from simple, isolated agricultural communities to the complex industrial and commercial society of to-day. The course consists of weekly lectures supplemented by textbook reading. Among the topics treated are natural resources; colonization, territorial expansion; manufactures; agriculture; finance; commerce; transportation; revenue tariffs; monopolies; governmental regulation; organization of labor; industrial legislation; immigration; conservation; contemporary problems. During the year each student will be required to write two or more theses on subjects connected with industrial history, in order that he may have practice in research work and also may continue his training in English. [All courses.]

Economics — E–7. Preparation: E–1, E–6. This course consists of lectures supplemented by recitations based upon both the lectures and a textbook. The

character of the course is descriptive rather than theoretical, and the aim is to acquaint the student with the accepted principles of economics and some of their applications to industrial conditions.

Among the topics discussed are the nature and scope of economics; the evolution of economic society; the three factors of production, land, labor and capital; the four elements in distribution, rent, wages, interest and profits; business organization; value and price; monopoly; money, credit and banking; international trade; protection and free trade; transportation; insurance; economic activities of municipalities; and public finance. In short, the course deals with the fundamental principles that underlie a wide range of activities. [Courses IV, VI.]

COTTON DEPARTMENT — F.

Yarn Manufacturing — F–1. Preparation: B–1, B–4, B–7. Instruction is given by means of lecture and laboratory work. The outline of the course is as follows: —

Fiber. — Before taking up the details of the operation of manipulating the fiber into yarn, a careful study is made of the characteristics and classification, both botanically and commercially, of the many varieties of the cotton fiber. Methods employed in cultivating, marketing, grading and stapling are considered, and under these heads a detailed study is made of the types of gin employed.

Opening and Picking. — Instruction in the preliminary operation of opening and picking covers the mechanical construction of the machines, their parts and adjustments, as fully as the manufacturing results accomplished by the machines. This includes such construction details as evener, lap measuring and safety stop motion, grids, cleaning trunks, beaters, etc.; also operation details which involve the adjustment of waste, drafts and character of laps.

Carding. — The process of carding is considered one of the most important, and proper time is devoted to the construction and operation of cards that the student may be familiar with the various parts of the card and the function and design of each. The construction and application of card clothing, as well as the methods of grinding, form a part of the work.

Drawing. — Under this head is taken up the theory of doublings and their effect upon the quality of roving and yarn. Like previous and subsequent processes the machine construction forms an important part of the work. Proper stress is paid to such subjects as stop motions, drawing rolls and their covering, cleaners and evener motions.

Roving Processes. — Under this head are studied the various machines known as the slubber, intermediate, fine and jack fly frames. The relative motion of the various parts of these machines is so complex that a good opportunity is here presented to fix in the student's mind the application of certain mechanical principles that are used in other departments and upon other machines in the manufacture of textile material. With each process of yarn manufacture are explained the systems of sizing and numbering, and under this head are taken up both the metric and English systems.

Yarn Manufacturing — F–2. Preparation: F–1. Ring Spinning and Twisting. — The consideration of spinning yarn by the ring frame method involves a knowledge of the uses to which the yarn is to be put, subsequent methods of handling that proper roving may be selected, suitable amounts of draft and twist provided, correct size of rings and travelers selected, building motions suitably adjusted, etc. The operation of twisting yarns is so closely related to spinning by the ring method that it is studied at the same time. This opens an almost limitless field of novelty yarn manufacture, and offers a very good opportunity to derive new types of yarn or new mechanism to produce the effects. Yarn defects are studied with reference to the cause and remedy.

Mule Spinning. — This method of spinning is very different from that of the ring frame, and the mechanical details are more complicated. The student is furnished with new means of producing yarns, and can compare the relative advantage of each method. A thorough understanding of mule spinning is perhaps more a study of mechanical motions and their functions. This results almost invariably in assisting the student to understand previous processes and machines better because of his work on the mule. It is the object to make clear to the

student's mind the principles underlying the construction and operation of the parts that control the drawing, twisting, backing off, winding, together with such special motions and devices as are used upon the modern mule.

Combing. — This process is explained by lecture work and by operation and assembling of the various types of combs in service in the laboratory. The object of combing is fully considered, and the different means employed on the many types of combers on the market is studied. This includes such types as the Heilman, New Whitin and Nasmith combers.

Organization. — Following the detailed study of the individual processes it is necessary to consider the relation of each to the other, the programs, balance of production, cost of machinery for various counts, quantities and styles of yarns. Under this heading are also studied such subjects as depreciation of machinery, cost systems, economics, arrangement of machinery, power demands, etc. [Courses I, III, VI.]

Knitting — F–3. Preparation: F–1–2 or G–1. This course, commencing with a study of hosiery yarns and their preparation for knitting, includes a study of the various stitches and their application in commercial fabrics; a study of the different knitting machines, including circular and flat spring and latch needle machines used in the manufacture of stockings, sweaters and underwear; and a study of looping and sewing machines. Part of the work consists of the assembling and adjusting of different types of knitting machines.

In addition, considerable time is spent in the analysis of knitted fabrics. [Courses I, II, VI.]

WOOL DEPARTMENT — G.

Yarn Manufacturing — G–1. Preparation: B–1, B–4, B–7. Raw Materials. — A study of raw materials which enter into the manufacture of woolen or worsted yarns, or are made into yarns by processes similar to those employed in the manufacture of woolen and worsted yarns, would include silk, mohair, alpaca, vicuna, cashmere, camel's hair, cotton, flax, hemp, jute and ramie. In connection with these are considered shoddy, noils, mungo and extracts.

Wool Sorting. — Familiarity with the various grades and kinds of wool is obtained by lecture and by actual sorting of fleece wool under the direction of an experienced wool sorter. The various characteristics and properties are explained, as are also trade terms, such as picklock, XXX, XX, $\frac{1}{2}$–blood, $\frac{3}{8}$–blood, $\frac{1}{4}$–blood, delaine, braid, etc. Some skill is acquired in the estimation of shrinkage and in judging the spinning qualities.

Wool Scouring. — The object of scouring and the methods employed are explained, and this involves the consideration of the soaps and chemicals used in washing; also the waste products and their utilization. Actual work is done in scouring a commercial quantity of wool by machines that are made similar in operation to regular commercial machines. A study is made of the effect of the hardness of water upon soap; also tests are made to show this effect. At the same time the use of driers, their operation and regulation, is taken up, and the methods of carbonizing wool, noils, burr waste, rags, etc., are studied and practiced.

Burr Picking, Mixing and Oiling. — In these processes, preliminary to carding, the students have an opportunity of mixing various colors of wools to produce different effects, and the influence of varying percentages of a given color in a mixture can be seen. Each student is required to make at least twenty sample mixes combining different colors and grades of stock, and to felt and mount the same. Under the subject of oils and emulsions are taken up the characteristics of various oils and the means employed to test these. The use of mixing and burr pickers is made clear.

Carding. — The different systems of carding wool, depending upon whether it is to be made into woolen or worsted yarn, are fully explained, as is also the construction, setting and operation of the cards. A part of the work is the reclothing and grinding of the cylinders, strippers, workers, etc. The carding of suitable and commercial quantities of wool, and the further manufacture of it into yarn, serves to fix the principles of carding in the mind of the student, as well as to give him some skill in handling machinery. At the completion of this part of the work he is required to prepare and hand in a full description of the process of carding,

including working drawings, sketches, etc., to fully explain the machines and the methods.

Woolen Mule. — The student studies thoroughly the operation of the mule as a whole, and acquaints himself with the various principal mechanisms, as, for example, the backing off and winding motions, the quadrant, builder-rail, faller regulation, etc.

Yarn Manufacturing — G–2. Preparation: G–1. Top Making and Combing. — This branch takes up, besides the carding of the wool on a worsted card, the preparing processes; also gilling of the stock before and after combing. The construction of the gill boxes and combs is studied by lectures, and by dismantling and assembling these machines in the laboratories. Later, quantities of stock are made into top and then into yarn.

The Noble and Lister combs are studied, and the various calculations to determine draft, noiling, productions, etc., are made.

Drawing and Spinning. — The equipment in the laboratory offers opprotunity to make worsted yarn by either the Bradford or open drawing system or by the French system. The process includes the various machines in the successive steps of making Bradford spun yarn, and the functions of the different machines are studied. In the latter, or French system, the stock is run through the drawing machines, and the roving spun into yarn on the French mule. The same method of studying the mechanisms and operation of these machines is followed as in the case of previous methods of instruction. The student by pursuing this course can compare the different methods of yarn manufacture and note the results of each.

With the instruction on the Bradford system is given work on the twisters and the effects that may be produced.

Organization. — At the end of the course the layout of a properly balanced yarn mill is studied, and at the same time the cost of the machinery, depreciation, labor costs and machinery arrangements. [Courses II, III, VI.]

Textile Testing — G–3. Preparation: F–2 or G–2, D–6, D–7, D–9. The object of this course is to familiarize the student with present-day methods of determining the physical properties of textile fibers, yarns and fabrics. The application of physical laws and methods of measurements, as studied in the Course of Physics, is used in the study of physical characteristics of textile material. The work is given to students in advanced courses, and consists of lecture and laboratory work. Reports are prepared from each experiment, giving the object of the experiment, method of procedure, observation and conclusions, in order that the student may acquire practice and understand the interpretation of data. A special testing laboratory is provided, and a considerable number of the best standard fiber, yarn and fabric testing instruments of foreign and American make have been installed and are used for instruction in the testing of textile materials. The laboratory is equipped with means of making and keeping the humidity constant, so that tests can be made under uniform or standard conditions of humidity and temperature. [All courses.]

FINISHING DEPARTMENT — H.

Woolen and Worsted Finishing — H–1. Preparation: B–4, C–1, D–1, D–9. The outline of this course, which is given by means of lecture and laboratory work, is as follows: —

Burling and Mending. — Under this head is taken up for consideration the examination of flannel as it comes from the loom; the construction, use and location of the perch; the methods used in marking defects, measuring, weighing and numbering of cloths; also the methods of inspection for fancies, single cloths and double cloths. The object of burling, mending and the types of tables employed, the method of removing knots, runners, etc., the object of back shearing and the use of burling irons, the replacing of missing threads and the importance of sewing as a part of the finishing process, are all considered in detail. The removal of oil and tar spots as well as stains of various kinds is studied.

Fulling. — This branch covers a study of the conditions of the flannel as it comes from the loom, and the influence of oil, etc., upon the procedure. Considerable time is devoted to the various methods of producing a felt, the early types of

stocks, hammer falling and crank stocks, and their modifications and development into the present type of rotary fulling mills of both the single and double variety. The details of construction in all machines are carefully taken up and include the design and composition of the main rolls, methods of covering, regulation and means of adjusting the pressure of traps and rolls, consideration of the shoes, the use and regulation of the various types of stop motion, the different types of stretchers, guide rolls and throat plates.

The theory of felt is taken up and the influence of pressure, moisture, heat, alkali and acid is considered, as well as the hydroscopic and felting properties of different wool fibers. The preparation of the flannel for the mill and the usual methods of determining shrinkages, as well as the various methods of soaping, are given careful attention. The preparation of various fulling soaps and the value of each for the production of various degrees of felt, as well as the determination of the proper amount of alkali for various goods, are carefully studied and demonstrated. The manipulation of the various kinds of goods in the mill, viz., all wool, shoddies and mixed goods, is studied in classroom and by operation in the mill.

The change in weight and strength for each operation is carefully considered, as is also the value of the flocks made in each. A study of the various methods of flocking, such as dry and wet, is considered in both class and machine rooms. In each operation the defects likely to materialize are studied, as well as the cause thereof, and various methods of modifying or lessening them.

Washing and Speck Dyeing. — This branch considers the scouring, rinsing and washing of goods both before and after the fulling process; the various types of washers; and the details of construction, such as suds box, rolls, etc. The theory of scouring, uses of Fuller's earth, salt solutions and scours on the different kind of goods are made clear by practical work in the machine room, where the effects due to improper scouring, such as stains, cloudy effects, wrinkles and unclean goods, are demonstrated. The discussion of the necessity of speck dyeing follows naturally from the study of these matters, and includes methods of preparation, materials used, application and tests required.

Carbonizing. — This is an important branch of finishing, and includes a study of the various carbonizing agents, methods of application, strength of solutions, and neutralizing, as well as the machines used. Stains and imperfections resulting from carbonizing are also considered. The drying and tentering machines and extractors employed are taken up at this point.

Gigging, Napping and Steaming. — The construction in detail of the various types of gigs, nappers, steamers, wet gigs, rolling, stretching, crabbing and singeing machines is discussed, and their actions upon the cloth and the results obtained are explained.

Various methods of obtaining luster and the production of permanent finish are considered in connection with steaming and sponging.

Brushing, Shearing and Pressing. — This includes, as do the other branches, a careful treatment of the machine employed, the preparation of the cloth for each process, the action of each machine in producing its part of the resultant effect. In manipulation of the shear consideration is given to its setting, grinding and adjustment. With the brushing machine the effect of steaming and moisture upon the luster and feel of the goods is shown. A study of the action of the presses, both plate and rotary, involves consideration of pressure, steaming, etc. Special processes to obtain particular effects are taken up, and the part played by each machine is explained. The details involved in handling cloth on a commercial scale, as, for example, measuring, weighing, ticketing, numbering and rolling, are also explained. The necessary calculation and the methods of finishing all grades of goods are considered from time to time during the year. [Courses II, III, IV, VI.]

Cotton Finishing — H–2. Preparation: B–4, C–1, D–1, D–9. The outline of the course in the finishing of cotton fabrics is as follows: —

Cloth Room. — Instruction of the various goods and the object thereof; construction of the various types of inspecting and trimming machines.

Shearing. — The object. A consideration of the various types of shears for treating one or both sides at the same time; also the use of the usual cleaning devices, such as emery, sand and card rolls, beaters and brushes; grinding and the adjustment of the various parts.

The use of brushing and cleaning machines, rolling devices and calender attachments for gray goods.

Singeing. — Developing and object of singeing; the construction of singers of all types, and for various purposes; the use of cooling tanks, steaming devices, rolling and brushing attachments.

Regulation of the flame for various goods, and adjustment of the parts; gas and air pressure, water-cooled rolls; the effect of moisture on the cost of singeing; the use of dry cans in connection with singeing; electric singeing.

Washing. — Open width and string washers, their construction and operation; soaps, temperature, squeeze rolls; washing of various goods and the object thereof; stains.

Napping. — The object of napping and the usual method of treating goods; various types of nappers, single and double acting; felting nappers; construction, grinding and adjustments of various types.

Water Mangles. — Their objects and the construction of various types; various rolls, iron, husk, etc.; scutchers, their object and constructions.

Starch Mangles. — The object and construction of all types of starch mangles for pure starch and filled goods; various types of rolls, brass, rubber, wood; action of doctor blades, etc.; regulation and object of pressure.

Methods of starching and finishing all standard goods, also a consideration of the various substances used, such as starch, softener and fillers; the preparation of starch and various methods of application.

Dryers and Stretchers. — Both horizontal and vertical, tenter frames, clips; the swing motion and the finishes thus produced; construction; spraying machines, belt stretchers, button breakers; their object and construction.

Calenders. — The object and construction of all types, including the regulation of pressure and nips for the production of various finishes; various types of rolls and their uses, — steel, husk and paper; the use of hot and cold rolls; chasing, friction, embossing and Schreiner calenders, and the various finishes produced by each; production of watered effects; beetling machines.

Making up room, — yarding, inspecting; different types of folds; pressing, papering, marking. [Courses I, III, VI.]

PHYSICAL EDUCATION — I.

All members of the freshman class are required to take a course in physical training conducted in the gymnasium under the direction of an instructor in physical education. Two periods per week for the entire first year are devoted to this work. At the beginning of the year a full record is made of the physical examinations carried on by the instructor and a reputable physician that proper and beneficial exercise may be prescribed.

The object is to give general instruction in the care and strengthening of the body, and to so guide the students that they may continue to give proper thought to their physical training that their mental development may have its greatest effect.

Proper gymnasium clothing is required and all students must take a shower bath following each exercise.

BUILDINGS AND GROUNDS.

The site is a commanding one, consisting of about 15 acres at a high elevation on the west bank of the Merrimack River. It extends to and overlooks the rapids of Pawtucket Falls, which was the first water power in America to be used on an extensive scale to operate power looms. It was contributed by Frederick Fanning Ayer, Esq., of New York City, and the Proprietors of the Locks and Canals on the Merrimack River.

Southwick Hall, the main building, fronting on Moody Street, was contributed by the Commonwealth of Massachusetts and Frederick Fanning Ayer, Esq., and is a memorial to Royal Southwick, a leading textile manufacturer, a public man of earlier days, and a maternal ancestor of Mr. Ayer. It includes a central mass 90 by 90 feet, having three stories and two wings 80 by 85 feet each with two stories and well-lighted basements. The building is pierced in the center by an arched way from which access is had to the wings and to the central courtyard.

The northern wing is occupied by the General Offices, Engineering and Finishing departments, and Library, while the southern wing is entirely occupied by the Chemistry and Dyeing departments.

Kitson Hall, dedicated to the memory of Richard Kitson, was contributed by Charlotte P. Kitson and Emma K. Scott, his daughters; the Kitson Machine Company of Lowell, founded by Mr. Kitson, was also a generous contributor. This hall makes a right angle with Southwick Hall, is 70 by 183 feet, and has two stories and a basement. The first floor is occupied by the Cotton Yarn and Knitting departments, while the basement contains the Mechanical and Electrical Engineering laboratories and the Machine Shop.

The Falmouth Street Building forms the third side of the quadrangle, and consists of three portions, one 60 by 75 feet, three stories, one 75 by 130 feet, three stories, and the head house 70 by 80 feet, three stories and basement. The building is occupied by the picker section of the Cotton Yarn Department, the Design and Power Weaving Department and by the Woolen and Worsted Yarn Department, and contains on the lower floors an equipment for the manufacture of wool yarn from the fleece to the finished yarn. The upper floors are occupied by a great variety of plain, dobby and Jacquard looms, and in a section of the building are the students' lockers and recreation rooms.

Colonial Avenue Building was erected in the summer of 1910 from plans prepared by the Engineering Department, which also had in charge the work of construction. The building completes the fourth side of the quadrangle, and in outward appearance corresponds to the architectural features of the other school buildings. It is a single-story building, and has the dimensions of 195 by 60 feet. Its interior is faced with cement brick made at the school during the progress of the work. These serve to give light reflecting walls which are advantageous for the work of the Wool Manufacturing, Cotton Finishing and Chemistry and Dyeing departments that occupy this building. The funds for this building were provided by the State of Massachusetts.

The buildings are all built of light brick with granite and Indiana limestone trimmings. They are of modern mill construction adapted to educational uses. The floor space of the several departments is as follows: —

	Square Feet
Cotton Yarns and Knitting	16,200
Woolen and Worsted Yarns	28,160
Textile Design and Decorative Art	16,806
General Chemistry and Dyeing Laboratories	28,400
Finishing Cotton, Woolen and Worsted	10,606
Power Weaving	15,360
Textile Engineering	24,297
Power plant	10,047
Assembly and physical culture halls	10,800
Entrances, corridors, stairways, etc.	14,487

Additional floor space is devoted to Administration, Offices, Library, classrooms, storerooms, etc.

CAMPUS.

Through the generosity of Mr. Frederick Fanning Ayer the school has been provided with a campus and athletic field of about 3 acres. This has been carefully graded and laid out for baseball, football and track athletics.

To enclose this field the Alumni Class Fence has been partly built. It is made of forged iron sections supported between brick columns. Each section is contributed by a class, so that in the course of a few years this fence will entirely enclose the field.

On the upper floor of the Falmouth Street Building there has been provided a recreation room for the use of the students at such times as their attendance is not required in classes.

In the basement of this building there are rooms for the use of the athletic teams. Connected to these are showers and dressing rooms.

The upper hall of Southwick Hall has been equipped with gymnastic apparatus. Chest weights, wooden dumb-bells, Indian clubs, a set of traveling rings, a vaulting horse, parallel bars, a punching bag and several sets of foils and single sticks have been provided.

In order to be sure that no student having any dangerous physical weakness takes part in any athletic contest, all candidates for the various athletic teams are obliged to pass a satisfactory physical examination.

EQUIPMENT.

The equipment of machinery, inventoried at $330,850.00, is most varied for textile educational purposes, and is being constantly augmented. The builders of the various machines installed keep in close touch with the school, adding to the machines such improvements as are made from time to time, and each year some new machine will be added by a manufacturer who finds it to his advantage to be represented here. This operates to the mutual advantage of student and manufacturer.

Cotton Yarns Department. — The opening and picking section of this department contains a 40-inch two beater breaker lapper with automatic feeder, a 40-inch single beater intermediate and finisher lapper with Perham & Davis sectional plate evener, apron to double four laps, a 40-inch single beater finisher lapper with Perham & Davis sectional plate evener, apron to double four laps, and a Kirschner patent carding beater, a roving waste opener and a thread extractor, all of which have been installed by the Kitson plant of the Saco-Lowell Shops at Lowell.

There is also a 50-saw gin from the Daniel Pratt Gin Company of Prattville, Alabama, besides facilities for teaching the grading and classification of cotton.

The carding, combing and drawing section contains the following machinery from the Saco-Lowell Shops: — a top flat card, three revolving flat cards, two of which form a unit for waste carding, three railway heads and two drawing frames. One of these cards is equipped by the Chapman Electric Neutralizer Co., Portland, Maine, with an electric neutralizer to prevent troubles from static electricity.

The Whitin Machine Works, Whitinsville, Mass., have installed a 40-inch revolving flat card, a sliver lapper, one four-head and a six-head ribbon lapper besides a two-head, a six-head and an eight-head comber.

The H. & B. American Machine Works of Pawtucket, R. I., are represented by the following pieces of machinery: — one 40-inch revolving flat card, one two-delivery drawing frame, a roving frame, spinning frame and ring twister.

The Foster Machine Company of Westfield, Mass., has provided two winders for making cones and multiple wound tubes.

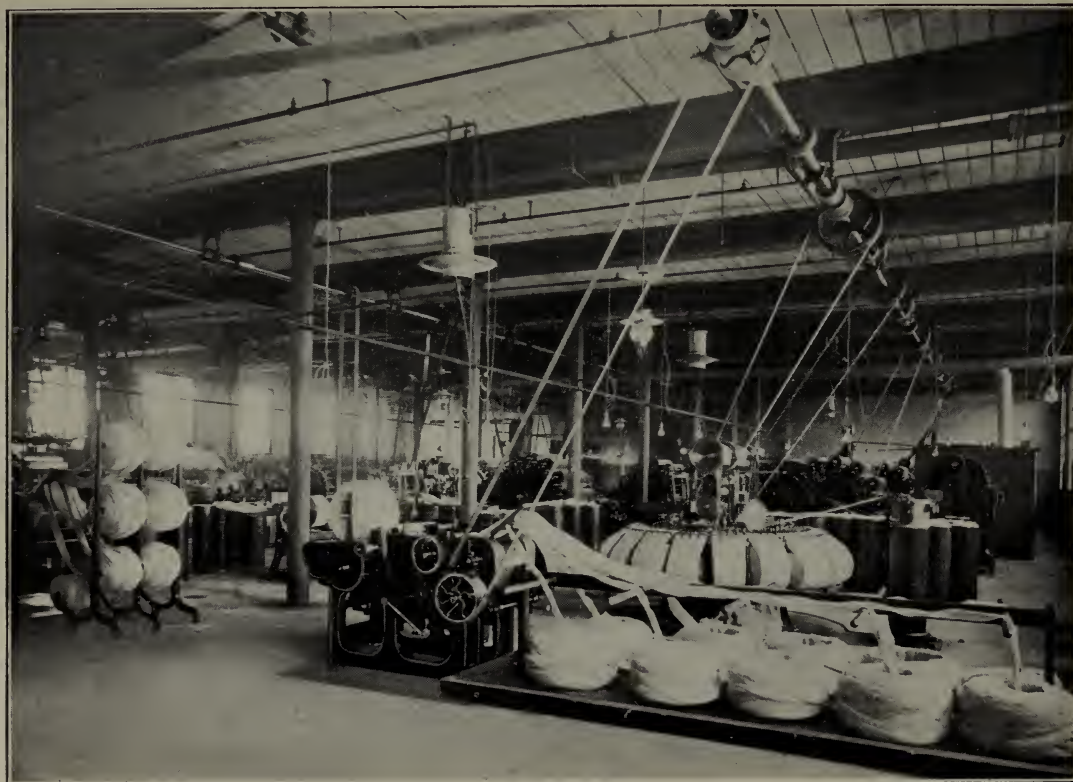
There is also a two-head comber with a model comber head made by John Hetherington & Sons, Ltd., Manchester, England.

The roving, spinning, and twisting section has the following machinery installed by the Saco-Lowell Shops of Lowell: — two slubbers one of which is for waste spinning, an intermediate, a fine and a Jack frame, also five ring spinning frames, a spinning mule, spooler and a wet and dry twister.

The Fales & Jenks, Pawtucket, R. I., and the Draper Corporation of Hopedale, Mass., have each provided a wet and dry twister; the Whitin Machine Works, three spinning frames, the Woonsocket Machine and Press Company, Woonsocket, R. I., an intermediate fly frame, and the Asa Lees Company, Oldham, England, through their agents, Wm. Firth Company, a fine spinning mule.

Knitting Section. — The winders for this section include a six-spindle Universal winder for cones and tubes and a Payne bobbin winder.

The machines in the following group are equipped with special attachments for producing lace front work, high splicing, double soling and striped work. The hosiery machines include two Acme full automatic, one arranged for 160 needles and the other for 200 needles; also a Mayo Model C full automatic arranged for 220 needles. Scott and Williams have placed in this section three of their machines, two arranged for 220 needles and one arranged for 200 needles — Model B–5. There are three Banner machines, all full automatic, two of which are arranged for 220 needles each and one arranged for 200 needles. There is one Brinton full auto-



Wool Combing

matic arranged for 176 needles and one Branson hand machine arranged for 80 needles. For hosiery legs and tops there are 5 ribbers, made by the Wildman Company, with cylinders varying from 3½″–5¼″ and arranged for needles varying in number from 160–240; 2 Brinton ribbers, one arranged for 176 needles and the other 200 needles; 1 Brinton tie machine, 1¾-inch cylinder, 100 needles and 49 needles.

The underwear machinery consists of one Crane spring needle machine, one Scott & Williams ribber, and one Wildman ribber.

Under the group of flat machines there are three Lamb machines, one arranged for knitting gloves and one arranged for knitting sweaters. In addition to these there is also a Grosser sweater machine, a Jacquard machine, and a link and link machine; a Dubied scarf machine; and a Raschel warp knitter.

For finishing work this section includes a Grosser 2-thread looper, one Hepworth looper, two Beattie loopers; 5 Union special sewing machines for over-seaming, double stitch covering, seaming and welting and vest finishing; 6 Merrow sewing machines, including two shell stitch machines and three over-seaming and crocheting machines; 3 Singer machines.

For instruction in the manufacture of braids the New England Butt Company has installed one 24-line Hercules braider, one 12-line braider, one tubular braider, and one soutache braider. To illustrate the preparation of silk warps the Atwood Machine Company, Stonington, Conn., has furnished a winder, a ribbon quiller, a warper and beamer, Swiss style, also a double frame to be used with these machines.

Wool Yarns Department. — For instruction in wool sorting and grading the room is provided and equipped with benches, baskets, etc., as well as standard samples of all grades of wool which may be used for comparison and examination.

The scouring and carbonizing equipment installed by C. G. Sargent's Sons Corporation consists of one cone duster for grease wool; four scouring bowls arranged in tandem with necessary feeds and modern carrying properties; one single apron dryer, with automatic feeder; one carbonizing screw acid tank and duster, with crush rolls. In this same department the North Chelmsford Machine Company have supplied a rinse box; Schaum & Uhlinger, one hydro-extractor; C. S. Dodge, one shoddy picker and one bagging stand.

Woolen. — In the woolen section there has been installed by the Atlas Manufacturing Company a Parkhurst Burr picker. The Davis and Furber Machine Company have installed a mixing picker equipped with improved mixing picker feed and Spencer oiler, both made by George S. Harwood & Son, Boston, Mass. There are three sets of woolen cards furnished by Davis and Furber Machine Company which are equipped with Bramwell feed furnished by George S. Harwood & Son. One of the sets has the first and second breaker cards coupled. All have apron condensers on the finishers. There is a sample mixing card furnished by the Torrance Manufacturing Company which offers an opportunity for carrying on experiments and mixing various kinds and colors of wool. There are two spinning mules, 120 spindles each, one furnished by the Davis & Furber Machine Company of North Andover and equipped with bobbin holders supplied by the American Bobbin Holder Company, West Medway, Mass., and the other furnished by Johnson & Bassett, Worcester, Mass. In addition to these two mules each company has supplied for the purpose of instruction a spinning mule head mounted on movable platform to facilitate class instruction. Besides these mules the Davis & Furber Machine Company have supplied a fancy yarn twister, 20 spindles; the Lindsay Hyde Company a modern skein winder. For Card grinding the B. S. Roy and Son Company of Worcester, Mass., have supplied one grinding frame and two traverse grinders; T. C. Entwistle Co., Lowell, Mass., one traverse grinder; W. H. Brown, Worcester, Mass., one complete set of carder's tools.

Worsted. — In the worsted section the Davis & Furber Machine Company have furnished one double-cylinder worsted card (4 licker-in) with Bramwell feed. On this card as well as one in the woolen section the Chapman Electric Neutralizer Company have supplied one of their patented electric neutralizers. This section also includes a double bowl, 5-cylinder back-washer, with gill box, Taylor-Wadworth & Co., Leeds, Eng., equipped with blueing motion, oiling motion, and Layland patent pressure motion; a weigh gill box and creel and one doubling balling

head gill box (with double screws) made by the Saco-Lowell Shops of Lowell, Mass.; a worsted comb with baller punch made by Crompton & Knowles, Worcester, Mass.; two finishing gill boxes, one known as a can gill box and the other a balling head gill box, both made by Hall & Stell, Keighley, Eng.

For the manufacture of yarns under the Bradford System of Drawing, Spinning and Twisting the following machinery as made by Prince Smith & Son, Keighley, Eng., make up the equipment: one revolving creel for 12 balls, one 2-spindle drawing box, one 4-spindle first finisher, one 12-spindle dandy reducer, one 12-spindle cap spinner, one double head can gill box, one 2-spindle gill box, one 2-spindle flyer spinner, one 12-spindle ring spinner, one 12-spindle 2-fold cap twister, one 12-spindle 6-fold ring twister. In addition to this the Saco-Lowell Shops, Lowell, Mass., have installed the following machinery to carry on similar work: one 2-spindle drawing box, one 6-spindle second finisher, one 24-spindle dandy rover, one 6-spindle cone reducer, one 8-spindle cone rover, one 48-spindle cap spinner, 5-foot end, one 48-spindle cap spinner, 4-foot end, one 48-spindle Boy ring twister. For conditioning yarn C. G. Sargent's Sons Corporation have supplied one of their conditioning machines. The Universal Winding Company have installed one of their 6-gang winders, equipped for cones or straight tubes.

The humidity in the laboratory of the woolen yarns and of the English system of worsted yarns is maintained by the American Moistening Company's system through their automatic control. In this laboratory are installed six humidifiers and four Comins' High Duty heads, which are supplied from an electric driven triplex power pump located in the power house. This same pumping equipment supplies the American Moistening Company's humidifiers operating in the Cotton Yarn Department.

For the manufacture of worsted yarns under the French System of Drawing and Spinning the machinery has been made by the Societe Alsacienne de Constructions Mechaniques, Mulhouse, France, and the equipment consists of the following: Model P. L. B. comb with creel for 24 doublings, intersecting gill box (2 heads), gill box (2 heads), first drawing (2 heads), second drawing (2 heads), third drawing (2 heads), reducer (4 porcupines), slubber (8 porcupines), first intermediate (8 porcupines), second intermediate (8 porcupines), rover (8 porcupines), finisher (16 porcupines), self-acting worsted mule (150 spindles).

The Saco-Lowell shops have recently built and installed a ring spinning frame of 60 spindles for worsted yarns equipped with individual General Electric Company's motor and a Reeves Variable Speed Transmission.

Twelve turbo humidifier heads automatically controlled by a humidity regulator have been furnished by the G. M. Parks Company, Fitchburg, Mass. The compressed air for these heads is supplied by an Ingersoll-Rand 8 by 8 steam-driven air compressor.

For the purpose of determining the physical properties of fibers, yarns, and fabrics there has been installed a Textile Testing Laboratory where there are the necessary microscopes and micrometers, a skein testing machine, an electric conditioning oven made by the Emerson Apparatus Company of Boston; single yarn and fabric strength testing machines made by G. R. Smith & Co., Bradford, England; a strength testing machine, capacity 500 kilograms, for testing twines and fabrics; a fiber testing machine for testing fibers and fine yarns with capacity, 1 gram to 1.5 kilograms; a yarn strength testing machine with capacity, 1,000 to 5,000 grams; and a yarn strength testing machine with capacity, 5 to 30 kilograms, all of which have been made by Louis Schopper, Leipzig, Germany. Besides these we have a standard yarn and fabric testing machine as made by Henry L. Scott & Company of Providence, R. I., and a Mullen Tester. For the automatic control of temperature and humidity there has been installed by the American Moistening Company of Boston one of their automatic humidity and temperature regulators.

Design and Power Weaving Department. — In the fabric analysis section there has been provided chemical balances made by Voland & Sons and Christian Becker, necessary twist testers, microscopes, reels, etc., as well as a Torsion calculation balance made by the Torsion Balance Company of New York.

In the warp preparation department there has been installed by the Saco-Lowell Shops one of their spoolers besides a warper and a slasher for preparing

cotton warps; a beamer by T. C. Entwistle Company of Lowell, a 400-end improved Draper warper furnished by the Draper Corporation of Hopedale, Mass. The Whitin Machine Company, Whitinsville, Mass., have supplied a 180-spindle, long-chain quiller and the Johnson & Bassett Company, Worcester, Mass., a quiller of their make. The Universal Winder Company has supplied a winder for copy and bobbin winding and an 8-spindle doubler.

The woolen and worsted warp preparation department contains two 40-end Jack spoolers, two spool racks for 12 spools each, one pattern dry frame dresser, one pipe and cylinder dresser, one 60-inch reel, one 82-inch reel, and one double head beamer, all supplied by the Davis & Furber Machine Company of North Andover, Mass.

The Weaving Department contains four looms supplied by the Draper Corporation of Hopedale, Mass., which include a plain Northrup, an 8-harness corduroy, an improved Northrup, a Northrup with dobby. The Stafford Loom Company of Readville, Mass., has installed one plain, one cam, one dobby loom and one broad sheeting loom all equipped with individual motors; the Whitin Machine Works, Whitinsville, Mass., a side cam twill, a plain print cloth loom, equipped with Kip-Armstrong electric warp stop motion; the Kilburn and Lincoln a plain loom; Lewiston Machine Company a 4-harness side cam and a bag loom; Crompton and Knowles Loom Works a jean loom and a plain loom with individual drive. Four of these looms are equipped with Abbott cleavers made by the Abbott Wire and Cast Steel Warp Cleaving Company, Lisbon Falls, Me. The Hopedale Manufacturing Company of Milford, Mass., has recently installed one of its high speed plain looms with individual motor.

The fancy loom section includes a Stafford Ideal 16-harness automatic shuttle-changing loom, a Whitin 20-harness dobby loom and the following furnished by the Crompton-Knowles Loom Works: — Knowles gingham 4 by 1 boxes, Crompton gingham 4 by 1 boxes, one Crompton towel 2 by 1 boxes, two Terry towel and one huck towel looms, a 16-harness lappet loom, a 20-harness dobby 4 by 1 boxes, fancy leno loom, and a Crompton fancy cotton single cylinder 20-harness dobby.

The woolen and worsted section contains a Knowles 20-harness Gem, a Crompton 24-harness worsted 4 by 4 boxes, a Crompton 6 by 1 double cylinder 20-harness dobby, one heavy 20-harness 4 by 4 boxes, one 20-harness and one 25-harness blanket, seven intermediate woolen 25-harness 4 by 4 boxes and two 90-inch 25-harness heavy woolen looms.

The Jacquard loom section includes one Stafford silk loom, 1,200-hook, Halton head; one 400-hook, single-lift, Schaum & Uhlinger Jacquard, mounted for 4-bank, narrow fabric loom; one Felix Tonnar German plush loom, with 400-hook Crompton & Knowles Jacquard head; one Skinner Brussels carpet loom, three-quarters wide, equipped with 1,280-hook Jacquard head presented by the Bigelow-Hartford Carpet Company, Clinton, Mass. The Crompton & Knowles Loom Works have furnished one Knowles fancy loom, single-lift Jacquard; one Knowles fancy loom, double-lift Jacquard; one Knowles fancy loom, Jacquard tied up for leno, one Knowles ingrain carpet loom, 4 by 4 boxes, one Knowles loom, 4 by 4 boxes, 54-inch, with 600-hook, double-lift, double-cylinder McMurdo Jacquard head, tied up for damask napkin designs, one Crompton ingrain carpet loom, 4 by 4 boxes, one Crompton & Knowles 72-inch tapestry loom, with 2,600-hook Halton Jacquard head, one 840-hook, double-lift, single-cylinder Jacquard on Crompton & Knowles 4-bank ribbon loom, one 800-hook, double-lift Knowles Gem silk brocade Jacquard machine, 4 by 4 boxes.

For the purpose of card cutting there has been furnished one Jacquard fine index card-cutting machine by John Royle & Sons, Paterson, N. J.; one Jacquard French index card-cutting machine by the same concern and one Jacquard French index card-cutting machine, presented by the Bigelow-Hartford Carpet Company, Lowell, Mass.

Chemistry and Dyeing Department. — The Chemistry laboratories consist of one to give instruction in General Chemistry and Qualitative Analysis and provides facilities to take 120 students. The Quantitative Laboratory takes care of some 50 students and contains the necessary drying closet, steam bath, electrolytic table, with ample facilities to provide distilled water through the use of a Barnstead Water Still. The Balance Room which is adjacent to the laboratory

has eleven analytical balances made by such concerns as Christian Becker, Eimer & Amend, and H. L. Becker's Sons & Co. The Organic Laboratory has facilities to take care of approximately 25 students having the necessary equipment required in the preparation of basic organic compounds and instruments used in the manufacture of dyes such as autoclaves, electric and gas combustion furnaces.

For the purpose of carrying on photographic and microscopic experiments and analyses the laboratory has been provided with equipment which includes besides the Bausch & Lomb microscopes, a polariscope made by Franz Schmidt & Haensch, Berlin, Germany, a Gaestner spectroscope, a Bausch & Lomb Model G photomicrographic apparatus equipped with D. D. S. microscope and all necessary apparatus, a Kodak projection printer. In the dark room there has been placed a piece of apparatus for determining the relative fading powers of various light sources. Besides the common gas and electric lamps there is installed a solar determinator, made by the Atlas Electric Company, Chicago, Ill., also a 400-watt Nela Trutint and color matching unit made by Nela Specialties Division, Cleveland, Ohio.

The Chemical Museum has been provided with cases and representative dyestuffs all furnished by various dyestuff manufacturers of this country and abroad. This offers an unparalleled opportunity for students to study and experiment with almost all of the representative dyes which are used in the textile industry.

The Experimental Dyeing Laboratory is equipped with individual benches, small dyeing apparatus, reels, balances, apparatus for dye testing, such as frames for exposing dyed material to light, and a complete collection of dyestuff samples and sample cards. There are also fifty-six steam coil experimental dyeing baths, a drying chamber and aging chamber, in addition to a Hurricane Dryer, Class D, made by the Philadelphia Drying Machinery Company, Pennsylvania. Adjacent to the Experimental Dyeing Laboratory there has been provided a well-lighted room for the storage of a great variety of dyestuffs. Steel shelving has been arranged so that the samples are easy of access. All samples are catalogued in a card file, thus facilitating their use. In this same room are provided a sink and cement table with balances.

The Experimental Printing Laboratory is equipped with a calico printing machine, made by Mather & Platt, Manchester, Eng., an iron jacketed steaming chamber from A. Edmeston & Son, Patricroft, Eng., and a set of steam jacketed copper kettles.

The Fuel and Oil Analysis Laboratory contains the following equipment for the analysis of coals and fuels: a Mather bomb calorimeter, with complete outfit, an Emerson bomb calorimeter, with complete outfit, a Parr calorimeter, an Abbe refractometer, a Torsion viscosimeter, a Tagliabue viscosimeter, a Tagliabue cold test apparatus, a Pensky Martin oil tester, a New York State oil tester, a Sartorius specific gravity balance, two Becker analytical balances, gas muffle furnace, Kny-Scherer oil tester, a Graefe gas calorimeter, an Orsat gas analysis apparatus, laboratory tables, lockers, and hoods.

The Industrial Chemistry Laboratory contains the following: one filter press, Type E. T. Shriver & Co., a single-acting triplex plunger pump, Goulds Manufacturing Company, a vacuum drying apparatus, a surface condenser, a Packard vacuum pump, Norman Hubbard's Sons, a vacuum evaporator, Swenson system, American Foundry and Machine Company, a centrifugal, C. H. Chavant & Co., a double jar mill, F. I. Stokes & Co.

For the purpose of carrying on dyeing on a basis which is more comparable with commercial practice there is provided a laboratory which includes the following equipment: a small kier, fitted with E. D. Jefferson's circulating device, an electrolyzer for manufacturing bleaching solutions, the National Laundry Machine Company, Dayton, Ohio, a Permutit filter, the Permutit Company, New York City, a mercerizing machine, a raw stock dyeing machine, Klauder-Weldon Dyeing Machine Company, Yardley, Pa., a yarn dyeing machine, Klauder-Weldon Dyeing Machine Company, a jig dyeing machine, the Textile-Finishing Machine Company, Providence, R. I., a set of drying cans by the same concern, a chain dyeing machine, T. C. Entwistle Company, Lowell, Mass., a raw stock drying table, Proctor & Schwartz, Philadelphia, Pa., a padding mangle, Arlington Machine, Works, Arlington, Mass., a hydro-extractor, W. H. Tolhurst & Son, Troy, N. Y., a

Psarski experimental dyeing machine, a Hussong experimental dyeing machine, equipped for raw stock or yarns, a Rodney Hunt sample piece dyeing machine, equipped with an automatic temperature and pressure-regulating apparatus, made by C. J. Tagliabue Manufacturing Company, Brooklyn, N. Y. The Franklin Process Company, Providence, R. I., have furnished a 25-pound bronze dyeing machine. Of the various dye tubs, one is equipped with a Monel Metal lining to withstand the action of various chemicals and dyes.

Finishing Department. — The Woolen and Worsted section includes a 2-string washer, a fulling mill, furnished by the Rodney Hunt Company, Orange, Mass.; a sample fulling mill, a kicker mill, furnished by James Hunter & Co., North Adams, Mass.; an up and down dry gig, a rolling and stretching machine, an up and down wet gig, a steam finishing machine, a 60-inch, 3-burner singeing machine, adapted for cotton, silk or worsted goods, a 2-cylinder double-acting brushing machine, a 60-inch, 4-cylinder sanding and polishing machine, furnished by Curtis & Marble, Worcester, Mass.; a 6/4 double shear, an A. W. C. measuring and weighing machine, furnished by Parks & Woolson, Springfield, Vt.; a dewing machine, a 6/4 Voelker rotary press, furnished by G. W. Voelker & Co., Woonsocket, R. I.; a single shear, Curtis & Marble, donated by Massachusetts Mohair Plush Company, Lowell, Mass.; a tentering and drying machine furnished by John Heathcote, Providence, R. I.; a single crabbing machine, H. W. Butterworth & Son, Philadelphia, Pa.; a 72-inch woolen napper, Davis & Furber, North Andover, Mass.; a 32-inch basket hydro-extractor, W. H. Tolhurst, Troy, N. Y.; a Lintz & Eckhardt cloth numbering machine, improved by Durbrow & Hearne Manufacturing Company, New York; a steam press for underwear, United States Hoffman Company, Syracuse, N. Y.; a sewing machine, Birch Brothers, Somerville, Mass.

The Cotton section includes a 40-inch inspecting and brushing machine, a 44-inch No. 25 railway sewing and rolling machine, a 44-inch cotton shearing machine, Type No. 34, a 44-inch No. 3 steam calender rolling machine, a 40-inch cloth folder, a 40-inch winder and measurer, a set 44-inch shear blades for grinding purposes, furnished by Curtis & Marble, Worcester, Mass.; a 48-inch No. 4 opening, sewing and re-rolling machine, a No. 1 hand power portable railway sewing machine, furnished by Dinsmore Manufacturing Company, Salem, Mass.; a 40-inch, 3-roll water mangle, with husk and brass rolls and usual attachments and equipped with a 48-inch Mycock scutcher, and a 40-inch Mycock cloth expander made by Thomas Leyland & Co., Boston, a 40-inch, 2-roll starch mangle, a 40-inch upright drying machine with 10 copper cylinders equipped with Files dry can system, Files Engineering Company, Inc., Bridgeport, Conn., a 40-inch sprinkler, a 40-inch, 5-roll Universal calender with chasing attachment and equipped with a 40-inch Mycock cloth expander, and a pasting table with plate, furnished by the Textile-Finishing Machinery Company, Providence, R. I.; a 16 by 24 inch bronze-covered stretcher for the drying cans, C. A. Luther & Co., Providence, R. I.; a 40-inch double bristle stretcher for drying cans, American Finishing Machinery Company, Boston, Mass.; a 40-inch Tommy Dodd starch mangle, H. W. Butterworth & Sons Company, Philadelphia, Pa., and a 44-inch, 50 foot vibratory tentering machine. This machine is directly driven by a 7½-horsepower variable speed motor and is equipped with a Schwartz automatic electric guider, made by L. H. A. Schwartz & Co., Boston, Mass.

Engineering Department. — The Steam Engineering Laboratory contains the following equipment arranged for experimental purposes: A 50-horsepower Allis-Chalmers Corliss steam engine direct connected to an Alden absorption dynamometer, and piped to exhaust its steam to the atmosphere, to a Wheeler surface condenser or to the Kerr turbine; a Kerr seven-stage turbine driving directly a 25-kilowatt Richmond Electric Company's alternating current generator and piped to exhaust either to the atmosphere or the condenser. It may be operated either as high pressure or low pressure turbine, and the generator has special connections to illustrate various commercial phases. In addition there are a 4 by 6 Deane triplex power pump, two 2-inch centrifugal pumps made by the Lawrence Machine Company, Lawrence, Mass., a Clayton air compressor and necessary tanks, scales and measuring instruments. For the measurement of flow of air there are a steam driven Sturtevant fan and a motor-driven Massachusetts fan with heater combined for heating and drying experiments.

For instruction in leveling and surveying there are provided three engineer's transits, leveling rods, etc.

The Electrical Engineering Laboratory consists of two sections, one of which is devoted to instruction in the generation and transmission of power, and contains the necessary switchboard and instruments to control a 25-kilowatt alternating current turbo generator and a 15-kilowatt motor-generator set arranged to supply either direct or alternating current. In addition there are a 24-horsepower direct current Allis Chalmers motor and a 10-horsepower direct current General Electric motor, also a 10 and a 7.5 horsepower General Electric alternating current motors besides a General Electric 3-kilowatt rotary transformer and three Westinghouse stationary transformers. The other section of the laboratory is known as the instrument laboratory and is for the purpose of giving instruction in the measurement of current voltage, resistance and in the calibration of instruments. It contains a 5-kilowatt Crocker-Wheeler balancer, a 160-ampere hour storage battery, a 5-kilowatt 220-volt to 440-volt General Electric transformer, a Westinghouse portable wattmeter with current and potential transformers, three wattmeters, two ammeters and a voltmeter all of the General Electric portable alternating current type, a 30-volt alternating current Roller Smith voltmeter, a 5 to 10-scale Weston ammeter (electro dynamometer type), a Weston millivoltmeter with 2, 20, 50 and 200 ampere shunts, three 250-volt direct current Weston voltmeters, a 150-ampere, two model 45, two model 260 Weston portable ammeters, a Weston model 260 voltmeter, a Thompson 50-ampere recording wattmeter, a General Electric rotating standard wattmeter, two General Electric induction type watt hour meters, an Esterline portable curve drawing wattmeter, a 100-ampere Leeds & Northrup Standard Resistance, a Leeds & Northrup Ayrton shunt, a Weston laboratory standard voltmeter with 600-volt multiplier, a Leeds & Northrup potentiometer, a D'Arsonval wall type galvanometer, a Wheatstone bridge with galvanometer, a slide wire bridge, and electrodynamometer, Weston Standard cell, potential phase shifter, a standard Leeds & Northrup photometer with Lummer-Brodhun screen, and Macbeth illuminometer made by the same concern.

Machine Shop. — The equipment of the machine shop is as follows: Four standard engine lathes, 13-inch swing, 6-foot bed, from Flather & Co., Nashua, N. H.; three standard engine lathes, 14-inch swing, 6-foot bed, from Flather & Co., Nashua, N. H.; a standard engine lathe, 15-inch swing, 6-foot bed, from F. E. Reed Company, Worcester, Mass.; an engine lathe, 18-inch swing, 10-foot bed, from Flather & Co., Nashua, N. H.; an engine lathe, 18-inch swing, 6-foot bed, from Champion Tool Works, Cincinnati, Ohio; a standard engine lathe, 15-inch swing, 6-foot bed, from S. H. Putnam Sons, Fitchburg, Mass.; five speed lathes, 17-inch swing, 5-foot bed, from J. G. Blount, Everett, Mass.; one No. I Universal milling machine, with all three feeds automatic, from Kempsmith Manufacturing Company, Milwaukee, Wis.; one 24 by 24 inch, 6-foot planer, from the Mark Flather Planer Company, Nashua, N. H.; one 23-inch upright drill, with back gears and power feed, from J. E. Snyder & Son, Worcester, Mass.; one 14-inch single sensitive drill, from the Stanley Manufacturing Company, Lawrence, Mass.; one No. 1 Universal grinder, from Landis Tool Company, Waynesboro, Pa.; one 20-inch wet tool grinder, from J. G. Blount, Everett, Mass.; one 12-inch, 2-wheel dry grinder, from J. G. Blount, Everett, Mass.; an American twist drill grinder, from the Heald Machine Company, Worcester, Mass.; one Type 1B portable electric grinder from the Cincinnati Electric Tool Company, Cincinnati, Ohio; one 30-inch grindstone and frame, from the Athol Machine Company, Athol, Mass.; a single spindle centering machine, from D. E. Whiton Machine Company, New London, Conn.; one 15-inch shaper, from Potter & Johnson, Pawtucket, R. I.; one power hacksaw, from the Fairbanks Company, Boston, Mass.; one cold saw, from John T. Burr & Son, Brooklyn, N. Y.; one Eureka metal power saw, Manning, Maxwell & Moore; one Type CC electric drill, Cincinnati Electric Tool Company; one Universal milling attachment for Kempsmith milling machine, Taylor Machinery Company; one Hisey Type B ½-horsepower tool post grinder, Taylor Machinery Company; one No. 2 Cory bench straightener, Manning, Maxwell & Moore; one No. 3 Universal cutter and reamer grinding machine, Browne and Sharpe; a well-equipped tool room containing a selected stock of the best makes of small tools, such as drills, taps and dies, milling cutters, reamers, gauges, micrometers, etc.

Power, Light, Heat and Ventilating Plant. — In the new power house, completed in 1913, there is located the main power-generating apparatus for supplying light, heat and power to all departments of the school. The equipment here consists of: two 250-horsepower Heine water tube boilers, equipped with Perfection grates, a 300-horsepower Aultman & Taylor horizontal water tube boiler, equipped with United States rocking grates, two boiler feed pumps — one a Knowles and the other a Deane — a 40,000-pound Cochrane metering open-feed water heater, which is provided with a Lea recorder, and a Cochrane oil extractor heats and measures all feed water, a 3-inch Venturi meter in feed line with indicating manometer as made by the Builders Iron Foundry, Providence, R. I. In the Engine Room are located: a Payne 14 by 14 automatic high speed engine, 125-horsepower direct connected to 75-kilowatt, 220-volt, direct-current Bullock generator, a 9½ by 11 Nash gas engine of 50-horsepower, 4-cycle type, with speed-regulating clutch and a "hit and miss" governor, direct connected to a 30-kilowatt, 220-volt, direct-current Bullock generator, a 65-kilowatt motor generator set, consisting of a direct current motor and an alternating current generator. This unit may be run either A. C. to D. C. or D. C. to A. C., and was made by the Westinghouse Electric and Manufacturing Company. A steam-driven Ingersoll-Rand 8 by 8 air compressor, for use with Turbo heads, installed in the French Spinning Department by the G. M. Parks Company, Fitchburg, Mass., a 5½ to 6 motor-driven air compressor, with 20 cubic foot storage tank for use in starting Nash gas engine, a Cross oil filter. The station switchboard is of marine-finished slate, 90 inches in height, and consists of three generator panels and two circuit panels.

The power house is connected with the main school buildings by a tunnel through which all wires, steam and water pipes are carried. The steam pipes supply heat to the buildings by means of direct radiation, and by means of the Sturtevant double duct heating and ventilating system located in the basement of Southwick Hall, and by the Sturtevant fan and heater located in the basement of Kitson Hall. Direct-driven exhaust fans are placed on the roof of Southwick Hall and in the basement laboratories.

ALUMNI ASSOCIATION.

The Alumni Association of the School holds its annual meeting and banquet in May of each year in Lowell, Mass.

The membership of the association is restricted to graduates of the day school. Honorary membership is open to the Board of Trustees, the faculty and such others as may be elected by the association.

Officers for the Year 1925–26.

Harold W. Cheney, '06, *President.*
Herbert A. Currier, '06, *Vice-President.*
Arthur A. Stewart, '00, *Secretary-Treasurer.*

Communications should be addressed to Arthur A. Stewart, Lowell Textile School.

Alumni Trustees.

Edward M. Abbot, '04
Edward A. Bigelow, '06
Henry A. Bodwell, '00
Thomas T. Clark, '10
William R. Moorhouse, '01
T. Ellis Ramsdell, '02
Royal P. White, '04

Executive Committee.

15 Members.

Philip H. Warren, '05, *Chairman*
James F. Dewey, '04
Leonard S. Farr, '08
Russell T. Fisher, '14
Harold B. Frost, '12
Olin D. Gay, '08
Arthur J. Hennigan, '06
Robert A. Julia, '06
Parker W. Longbottom, '21
Everett B. Rich, '11
Irving N. Stronach, '10
Ernest D. Walen, '14
J. Milton Washburn, '21
A. Edwin Wells, '20
Stanley H. Wheelock, '05

Note.—Officers and Alumni Trustees are ex-officio members of Executive Committee.

GRADUATES, JUNE 9, 1925.

Graduates, with Titles of Theses.

Bachelor of Textile Engineering.

Clarence Alfred Anderson, Norwood, Mass. "An Investigation to Show the Relation between Yarn Strength and Fiber Strength in a Twenty Three-five-three Cotton Tire Yarn."

Dorothy Myrta Ellis, Lowell, Mass. "The Effect of Regain upon the Strength and Elasticity of Woolen Fabrics."

Russell Todd Fisher, Boston, Mass. "A Study of the Methods and Instruments used in Measuring Gauge of Fabrics."

Milton Hindle, Lowell, Mass. "A Study of the Relation of Twist to the Breaking Strength and Elasticity of a Cotton Yarn when spun near the Spinning Limit." (With William D. Hollstein.)

William Diedrick Hollstein, Lowell, Mass. Thesis with Milton Hindle.

Carl Seth Sandlund, Nashua, N. H. "An Investigation of the Possibility of Using Increased Spinning Drafts on Cotton Ring Spinning Machinery." (With Edward J. Weinstein.)

Edward Joseph Weinstein, Hadlyme, Conn. Thesis with Carl S. Sandlund.

Tsung-Chieh Wu, China. "An Introductory Study of the Uniformity of a Cotton Strand during the Processes of Manufacture." (With Clarence W. L. Wu.)

Clarence Wen-Lon Wu, China. Thesis with Tsung C. Wu.

Bachelor of Textile Chemistry.

Raphael Edvab Cohen, Lowell, Mass. "The Action of Ultra-Violet Light on Wool."

Joseph Bailey Crowe, Lowell, Mass. "Development of an Improved Method for the Determination of Organically Combined SO_3 in Sulphonated Oils."

Parker Haywood DelPlaine, Lowell, Mass. "Study of Artificial Silks, especially with Reference to their Dyeing Qualities." (With George W. Pierce.)

Frederick William Hibbard, Lawrence, Mass. "A Study of Certain Derivatives of Para Cymene, with Special Reference to Possibilities of Utilization." (With Robert E. Sargent.)

Haven Asa Morrison, Lowell, Mass. "General Consideration of the Viscosity of Starch Solutions."

George Whitwell Pierce, Somerville, Mass. (Thesis with Parker H. Del Plaine.)

Harold Nelson Runnells, Concord, N. H. "The Fastness to Light of Goods Carbonized after Dyeing."

Robert Edward Sargent, Haverhill, Mass. (Thesis with Frederick W. Hibbard.)

Luis Jorge Villa, South America. "A Study of the Dyeing Properties of Nitrated and Denitrated Cotton."

Diploma Graduates.

Wool Manufacture.

Harold Palmer Bradford, Malden, Mass. "Study of Fabric Produced from Virgin Wool, Woolen Warp and Reworked Fiber Filling."

Russell Albert Carter, Andover, Mass. "Manufacture of Woolen Cheviot."

George Harry Gwinnell, Pittsfield, Mass. (Thesis with Russell A. Carter.)

Edward Linsey, Malden, Mass. "Study of Fabrics Produced from Worsted Warp and Reworked Fiber Filling."

James Bradley McKinstry, Southbridge, Mass. "Manufacture of Worsted Suiting."

Edward Francis Moore, Rockford, Ill. "Manufacture of Worsted Suiting."

William Albert Robinson, Lowell, Mass. "Manufacture of Worsted Suiting."

Benjamin Somers, Brookline, Mass. (Thesis with Edward Linsey.)

Henry Mundill Sutcliffe, Lowell, Mass. "Manufacture of Worsted Suiting."

Rodney Bernhardt Wilman, Brookline, Mass. (Thesis with William A. Robinson.)

LeRoy Ziock, Lowell, Mass. "Manufacture of Semi-Finished Men's Suiting."

Textile Design.

Howard Varnum Fletcher, Lowell, Mass.
Nahman Shenker, Lowell, Mass.

Prizes awarded in June, 1925.

The Medal of the National Association of Cotton Manufacturers awarded to the student taking course in Cotton who maintains the highest average in scholarship throughout this course. To *Milton Hindle.*

Saco-Lowell Prize of $100 for thesis prepared for graduation which will be considered of greatest value to the textile industry. To *Milton Hindle* and *William Diedrick Hollstein.*

Textile Colorist Award of $100 offered to a member of the graduating class whose thesis, based upon his personal researches and experiences, is of the greatest practical value to the dyeing, bleaching or textile finishing industries. To *Frederick William Hibbard* and *Robert Edward Sargent.*

Edward A. Bigelow Prize of $100 to the member of the graduating class from the Wool Manufacturing course who maintains the highest standing through his three years. To *William Albert Robinson.*

Edward A. Bigelow Prize of $50 to the member of the second year class in the Wool Manufacturing course who maintains the highest standing during his second year. To *Joseph Adrien Lussier.*

Edward A. Bigelow Prize of $25 to the member of the first year class in the Wool Manufacturing course who maintains the highest standing during his first year. To *Roger Dennis Smith.* Honorable Mention, *Edwin Thomas Hanscom* and *Thomas Francis Connor.*

Louis A. Olney Prizes (in the form of books).

$20 to the regular student in the Chemistry and Textile Coloring course who shall present the best thesis preparatory to graduation. To *Haven Asa Morrison.* Honorable Mention, *Parker Haywood DelPlaine* and *George Whitwell Pierce.*

$10 to the regular student of the Chemistry and Textile Coloring course who shall be considered as having attained the highest scholarship during his second year. To *Stephen Kenneth Ford.*

$5 to the regular student of the Chemistry and Textile Coloring course who shall be considered as having attained the second highest scholarship during his second year. To *Chester William Meyers.* Honorable Mention, *Thomas Joseph Tarpey* and *Clarence Hooper.*

$10 to the student taking the regular Chemistry and Textile Coloring course who shall be considered as having attained the highest scholarship in first-year Chemistry. To *John Vincent Killheffer.*

$5 to the student taking the regular Chemistry and Textile Coloring course who shall be considered as having attained the second highest scholarship in first-year Chemistry. To *Robert Burns.* Honorable Mention, *George Chester Ward* and *John Maglathlea Way.*

Herbert A. Currier Scholarship. — $100 given by Herbert A. Currier of the Class of 1906 to a student selected by the faculty of the school, the following conditions to be considered in making the selection: scholastic standing, financial need, and ability in promoting student activities in school life. To *Frederick Leo Kenney.*

REGISTER OF DAY STUDENTS.

Candidates for Degree.

Class of 1926.

Name, Home Address	*Lowell Address*
Baker, Franz Evron, VI, Winchendon, Mass.	28 Mt. Vernon Street
Brosnan, William Francis, IV, Lowell, Mass.	38 Second Avenue
Buchan, Norman Spaulding, IV, Andover, Mass.	———
Chase, Robert Wentworth, IV, Canton, Mass.	Omicron Pi House
Cote, Theodore Charles, IV, Groveland, Mass.	———
Godfrey, Harold Thomas, VI, North Andover, Mass.	Phi Psi House
Joy, Thomas, VI, Lowell, Mass.	28 Mt. Vernon Street

Kennedy, Francis Charles, VI, Holyoke, Mass.	Delta Kappa Phi House
Kuo, Limao, VI, Taichowfu, China	11 Mt. Vernon Street
McKay, Benedict Josephus, IV, Stoughton, Mass.	825 Merrimack Street
Mason, Philip Edwin, IV, Melrose Highlands, Mass.	Omicron Pi House
Mazer, Samuel, IV, Roxbury, Mass.	———
Meeker, Samuel, IV, Lowell, Mass.	295 Foster Street
Schreiter, Ehrich Ernest Max, VI, Walpole, Mass.	272 Merrimack Street
Smith, William Charles, IV, Chadwicks, N. Y.	Omicron Pi House
Sturtevant, Fred William, IV, Lowell, Mass.	60 Grove Street.

Class of 1927.

Dolan, William Francis, IV, Lowell, Mass.	56 Crowley Street
Farley, Clifford Albert, VI, Lowell, Mass.	215 Princeton Street
Flood, Thomas Henry, IV, Lowell, Mass.	49 Madison Street
Flynn, Thomas Joseph, IV, Pittsfield, Mass.	Delta Kappa Phi House
Ford, Stephen Kenneth, IV, Haverhill, Mass.	———
Franks, Jerome, VI, Brooklyn, N. Y.	106 Crawford Street
Glickman, Bernhardt, IV, Mattapan, Mass.	———
Goldenberg, Louis, VI, Brooklyn, N. Y.	17 Edson Street
Guild, Lawrence Winfield, VI, Quincy, Mass.	91 Mt. Washington Street
Hooper, Clarence, IV, Shirley, Mass.	———
McGuire, Edward Perkins, VI, Brookline, Mass.	14 Mt. Washington Street
McKinnon, Norman, VI, Lowell, Mass.	179 Princeton Street
Merrill, John Leslie, VI, Lowell, Mass.	96 Dingwell Street
Meyers, Chester William, IV, Billerica, Mass.	———
Parigian, Harold Hrant, IV, Hudson, Mass.	———
Parkin, Robert Wilson, VI, Maynard, Mass.	20 Hurd Street
Parsons, Charles Sumner, VI, East Milton, Mass.	793 Merrimack Street
Sawyer, Richard Morey, VI, Winchester, Mass.	———
Shea, John Francis, IV, Fitchburg, Mass.	Delta Kappa Phi House
Tarpey, Thomas Joseph, IV, Somerville, Mass.	Delta Kappa Phi House
Wingate, Edward Lawrence, Jr., VI, Malden, Mass.	Omicron Pi House
Woodbury, Kenneth Leroy, VI, Haverhill, Mass.	———

Class of 1928.

Anderson, Harry Eric, VI, Lowell, Mass.	39 Daniels Street
Birdsall, Edgar Wallace, IV, Southbridge, Mass.	Omicron Pi House
Burns, Robert, IV, Easthampton, Mass.	Phi Psi House
Cartier, Edward George, IV, Lowell, Mass.	141 Pawtucket Street
Corbett, James Francis, IV, Dracut, Mass.	———
Fasig, Paul Leon, IV, Reading, Pa.	125 Mt. Washington Street
Fitzgerald, John Francis, IV, Lawrence, Mass.	———
Forgeot, George Cutler, Jr., IV, Boston, Mass.	43 Plymouth Street
Fredrickson, Charles Joseph, Jr., IV, Shawsheen Village, Mass.	———
Goddard, Langdon Warren, VI, Concord Junction, Mass.	142 Riverside Street
Gottschalck, Lawrence, VI, Gloversville, N. Y.	121 Mt. Washington Street
Hetherman, Patrick Joseph, IV, Lowell, Mass.	306 School Street
Holbrook, Ralph Wentworth, IV, Allston, Mass.	———
Killheffer, John Vincent, IV, North Caldwell, N. J.	14 Mt. Washington Street
Konieczny, Henry, IV, Lowell, Mass.	1276 Bridge Street
Lindsly, Walter Coburn, IV, Lowell, Mass.	49 Nesmith Street
Logan, Leslie, VI, South Portland, Me.	Phi Psi House
McKittrick, Raymond Wellington, VI, Lowell, Mass.	15 Hawthorne Street
Morrill, Luther Choate, VI, Lowell, Mass.	571 Westford Street
Osborne, George Gordon, VI, Washington, Conn.	404 Fletcher Street
Reinhold, Kurt Herman, VI, Clifton, N. J.	Phi Psi House
Robinson, Marjorie Lorettor, IV, West Somerville, Mass.	193 Avon Street
Rodalvicz, Francis Rudolph, IV, Anthony, R. I.	Delta Kappa Phi House

Russell, William Samuel, Jr., VI, Haverhill, Mass.	———
Sampson, Clifford William, IV, Plymouth, Mass.	529 Moody Street
Simmons, Osborne Arthur, VI, Lowell, Mass.	3 Branch Avenue
Simpson, Robert, VI, Lowell, Mass.	201 Nesmith Street
Skinner, Everett William, VI, Lowell, Mass.	793 Merrimack Street
Slack, John Taylor, 2nd, VI, Springfield, Vt.	Phi Psi House
Storey, Alvin Briggs, VI, Lowell, Mass.	272 Merrimack Street
Sullivan, Willard David, VI, Lowell, Mass.	39 Loring Street
Tanguay, Gerard, IV, Lowell, Mass.	404 Fletcher Street
Tarshis, Elias Aaron, IV, Springfield, Mass.	Sigma Omega Psi House
Ward, George Chester, IV, Andover, Mass.	———
Warren, Eva Maybelle, IV, Billerica, Mass.	———
Westaway, John Chester, VI, Hamilton, Ont.	Phi Psi House
Whittemore, Fred Lincoln, Jr., VI, West Medford, Mass.	———
Wiech, Raymond Edward, IV, Lowell, Mass.	259 Beacon Street

Class of 1929.

Anderson, Alfred Ballard, VI, Framingham, Mass.	272 Merrimack Street
Anthony, Louis Lowell, IV, Lowell, Mass.	20 Loring Street
Balch, Ralph Herman, VI, Billerica, Mass.	———
Beardsell, Arthur Herrick, VI, Concord, Mass.	43 Plymouth Street
Bellemere, Benjamin Stanley, VI, Reading, Pa.	404 Fletcher Street
Bergeron, Alvin Wilfred, IV, Haverhill, Mass.	———
Buzzell, Harry Saville, VI, Lowell, Mass.	30 Highland Avenue
Ellis, James Oliver, VI, Chelmsford, Mass.	———
Fairweather, John Ross, VI, Jackson Heights, N. Y.	272 Merrimack Street
Folsom, Edward Ellsworth, VI, Swampscott, Mass.	272 Merrimack Street
Garrity, Edward Augustus, IV, Lexington, Mass.	———
Gilmore, Robert Edwin, VI, Lowell, Mass.	39 Walnut Street
Hale, Everett Lane, VI, Stoneham, Mass.	———
Haynes, Amos Kempton, IV, Haverhill, Mass.	———
Hickey, Thomas James, IV, Lowell, Mass.	24 Cedar Street
Holt, Lawrence Currier, VI, Lexington, Mass.	43 Plymouth Street
Howorth, Harmon, VI, Nashua, N. H.	71 Harris Avenue
Hurd, Ira Swain, IV, Haverhill, Mass.	———
Hyun, Chirl, VI, Kai Chun, Korea	272 Merrimack Street
Johnson, Russell Ingalls, IV, West Medford, Mass.	———
Johnstone, Edwin Parker, Jr., IV, New Haven, Conn.	142 Riverside Street
Jones, Mellor Adair, IV, Bridgeport, Conn.	137 Riverside Street
Larter, Edward Alan, VI, Lowell, Mass.	282 Pawtucket Street
Lindblad, Conrad Frederick, IV, Worcester, Mass.	142 Riverside Street
McGibbon, James Greig, IV, Lexington, Mass.	———
McIntosh, William Petrie, Jr., IV, Haverhill, Mass.	———
McLean, Earle Raymond, IV, Haverhill, Mass.	———
Marble, Roger Houghton, VI, Worcester, Mass.	159 White Street
Matthews, Robert Jackson, VI, Gardner, Mass.	137 Riverside Street
Morrissey, William Taylor, IV, Andover, Mass.	———
Murphy, Sylvester, IV, Hull, Mass.	123 Westford Street
Myers, Walter Flemings, VI, Lowell, Mass.	21 Albert Street
Parker, John George, Jr., IV, Chelmsford, Mass.	———
Phelan, Bernard Michael, IV, Ipswich, Mass.	825 Merrimack Street
Randlett, Charles Augustus, Jr., IV, Billerica, Mass.	———
Rice, Kenneth Earl, VI, Stoneham, Mass.	———
Robbins, Walter Archibald, VI, Lowell, Mass.	146 Hampshire Street
Ryberg, Bertil August, IV, Centerville, Mass.	272 Merrimack Street
Shelton, Charles Leopold, VI, Jamaica Plain, Mass.	———
Shrigley, George Edward, IV, Lowell, Mass.	23 Viola Street
Stacey, Alfred Charles, IV, Andover, Mass.	———
Stewart, Jack Weeden, IV, Brattleboro, Vt.	159 White Street

Westbrooke, Clayton Collington, IV, North Andover, Mass.	———
Zalkind, Benjamin Joseph, VI, Dorchester, Mass.	———

Diploma Students.

Class of 1926.

Name, Home Address	*Lowell Address*
Anderson, Harold Robert, II, Lowell, Mass.	20 Rose Avenue
Baker, William Samuel, I, Lowell, Mass.	812 Moody Street
Bentley, Byron, II, Methuen, Mass.	———
Burke, Francis Harold, III, Franklin, Mass.	Delta Kappa Phi House
Callahan, John Joseph, Jr., II, Somerville, Mass.	Delta Kappa Phi House
Connorton, John Joseph, Jr., III, Concord Junction, Mass.	Delta Kappa Phi House
Cranska, Floyd, I, Manchaug, Mass.	51 Sixth Avenue
Gallagher, Raymond Thomas, II, Lowell, Mass.	117 Methuen Street
Gilman, Ernest Dana, II, Methuen, Mass.	———
Gladwin, Albert Bangs, II, North Weymouth, Mass.	Omicron Pi House
Greenwood, John Roger, Jr., II, Millbury, Mass.	Omicron Pi House
Hathaway, William Tabor, II, Cambridge, Mass.	———
Hyde, Alvin Manning, II, East Brimfield, Mass.	Omicron Pi House
Isaacson, George Franklin, II, Waltham, Mass.	———
Kenney, Frederick Leo, II, Franklin, Mass.	Delta Kappa Phi House
Leavitt, George Herbert, II, Lowell, Mass.	37 Varney Street
Lussier, Joseph Adrien, II, Woonsocket, R. I.	793 Merrimack Street
MacKenzie, Ronald Smith, II, Concord Junction, Mass.	Omicron Pi House
Patenaude, Harold John, II, Ashuelot, N. H.	821 Merrimack Street
Redding, Leslie Capron, II, Woonsocket, R. I.	793 Merrimack Street
Ryan, David Louis, II, Natick, Mass.	Phi Psi House
Schneiderman, Jacob, III, Dorchester, Mass.	———
Simpson, William Martin, Jr., II, Malden, Mass.	Phi Psi House
Slamin, Alfred Francis, I, Wellesley, Mass.	37 Varney Street
Smith, Allen Batterman, I, Winchester, Mass.	23 Riverside Street
Stass, John George, II, Lisbon Falls, Me.	10 Roberts Place
Swain, Harry LeRoy, Jr., I, Kent, Ohio	Delta Kappa Phi House
Teague, Charles Baird, II, Somerville, Mass.	———
Vincent, William Henry, III, Hyde Park, Mass.	345 Walker Street
Yacubian, Levon Mardrois, II, Somerville, Mass.	Omicron Pi House

Class of 1927.

Barry, Leo Joseph, II, Cambridge, Mass.	———
Bassett, Walden Elbridge, I, Andover, Mass.	———
Battles, Samuel Cook, II, North Andover, Mass.	———
Bronson, Howard Seymour, II, Portage, Wis.	Delta Kappa Phi House
Burrage, Butler Dana, I, Lowell, Mass.	65 Harvard Street
Burtt, Richard Flint, II, Lowell, Mass.	23 Grace Street
Connor, Thomas Francis, II, Roxbury, Mass.	503 Beacon Street
Darby, Avard Nelson, II, Billerica, Mass.	———
Dods, James Barber, II, Alton, Ont.	51 Sixth Avenue
Feinberg, Benjamin, II, Newton Centre, Mass.	123 Riverside Street
Ferris, Arthur Leon, II, Port Rowan, Ont.	Phi Psi House
Frost, Edgar LeRoy, II, Reading, Mass.	Omicron Pi House
Gallagher, John Waters, II, Danbury, Conn.	Phi Psi House
Hanscom, Edwin Thomas, II, Sanford, Me.	10 Roberts Place
Keach, Elliott William, I, Fitchburg, Mass.	Phi Psi House
Noyes, Harold Albert, II, Lowell, Mass.	338 Fairmount Street
Peterson, Halvar Alfred, II, Waltham, Mass.	———
Pratt, Wallace Heywood, II, Braintree, Mass.	63 Varnum Avenue
Shedd, Jackson Ambrose, III, North Chelmsford, Mass.	———

Smith, Roger Dennis, II, Haverhill, Mass.	Delta Kappa Phi House
Somers, Samuel, II, Brookline, Mass.	———
Strout, Kenneth Edward, III, South Portland, Me.	37 Varney Street
Waite, Byron Osmond, I, Livermore Falls, Me.	10 West Meadow Road

Class of 1928.

Adams, Durward Webster, II, Claremont, N. H.	Omicron Pi House
Bauer, Harold Conrad, III, Lawrence, Mass.	———
Biggi, Harrison Andrew, III, Bedford, Mass.	———
Billings, Borden Dickinson, III, Auburndale, Mass.	147 Gershom Avenue
Bottomley, John, III, North Andover, Mass.	———
Breslauer, Benjamin Franklin, I, Milwaukee, Wis.	825 Merrimack Street
Campbell, William Malcolm, III, South Boston, Mass.	37 Varney Street
Coffey, Daniel Joseph, III, Pittsfield, Mass.	37 Varney Street
Davidson, Sydney, III, Roxbury, Mass.	———
deJong, Simon Sylvain, II, Brookline, Mass.	———
Evans, Paul Richard, II, Stoneham, Mass.	———
Frost, Robert Jones, II, East Douglas, Mass.	100 Riverside Street
Gaudet, Walter Urban, II, Pawtucket, R. I.	793 Merrimack Street
Hamlin, Perley Chamberlain, II, West Roxbury, Mass.	137 Riverside Street
Hyman, Wolfred, II, Roxbury, Mass.	———
Joslin, Harold Wheeler, II, Milford, N. H.	51 Sixth Avenue
Kiggins, James Francis, I, North Adams, Mass.	37 Varney Street
Kilton, Lyman Hayward, Jr., II, Worcester, Mass.	1599 Middlesex Street
MacKinnon, Howard Arthur, I, Boston, Mass.	———
Maguire, James Joseph, II, North Attleboro, Mass.	793 Merrimack Street
Mears, Charles, III, Quechee, Vt.	37 Varney Street
Pearlstein, Maxwell, III, Roxbury, Mass.	———
Pease, Cecil Jay, II, Hyde Park, Mass.	299 Dutton Street
Perry, Manfred Clement, I, Amherst, Mass.	123 Westford Street
Qualters, Edward Francis, III, Ashuelot, N. H.	821 Merrimack Street
Riedel, Robert Albert, II, Dorchester, Mass.	37 Varney Street
Ruiz, Gonzalo, I, Quito, Ecuador	142 Riverside Street
Stott, John Smith, III, North Andover, Mass.	———
Swanson, John Harold, I, Griffin, Ga.	Delta Kappa Phi House
Walker, Ian Campbell, II, South Gardner, Mass.	Omicron Pi House
Wetherbee, Francis Putney, I, Albany, Ga.	100 Riverside Street
Williams, Roger, Jr., II, Canton, Mass.	272 Merrimack Street

Special Students.

Adams, Ernest Albion, II, Dorchester, Mass.	123 Westford Street
Bachmann, Alfred Richard, III, Lowell, Mass.	146 Parkview Avenue
Brady, Leo Joseph, A. B., II, Uxbridge, Mass.	142 Riverside Street
Bullard, Edward Allen, I, Wrentham, Mass.	Phi Psi House
Clough, Byron Lambert, III, Hampden Highlands, Me.	142 Riverside Street
Crowe, Joseph Bailey, B. T. C., VI, Lowell, Mass.	220 Thorndike Street
Feustel, Kurt Erich, III, Passaic, N. J.	14 Mt. Washington Street
Harper, John Edward, I, Squantum, Mass.	Phi Psi House
Leonard, Leo Edward, I, Worcester, Mass.	Phi Psi House
McArthur, John Maurice, VI, Lowell, Mass.	32 New York Street
Milliman, Arthur Smith, I, Loudonville, N. Y.	106 Crawford Street
Ray, Edna, B. S., III, Manistee, Mich.	193 Avon Street
Rice, Walter Franklin, VI, Manchester, N. H.	———
Savage, Lawrence Alexander, I, Camden, S. C.	784 Merrimack Street
Steward, Paul Lowden, III, Skowhegan, Me.	Phi Psi House
Stickler, John George, III, New Lisbon, Wis.	43 Plymouth Street
Sullivan, Richard O'Brien, II, Groton, Mass.	Delta Kappa Phi House
Watts, Stirling, I, Glen Ridge, N. J.	63 Varnum Avenue
Wiesner, Alfred Maxwell, III, Manchester, N. H.	Omicron Pi House
Wyatt, Andrew Harper, III, Fitchburg, Mass.	Omicron Pi House

ALPHABETICAL LIST OF GRADUATES.

The following list has been corrected in accordance with information received previous to February 1, 1926. Any information regarding incorrect or missing addresses is earnestly solicited.

B.T.C. indicates the degree of Bachelor of Textile Chemistry; B.T.D. indicates the degree of Bachelor of Textile Dyeing; B.T.E. indicates the degree of Bachelor of Textile Engineering; D indicates a diploma; C indicates a certificate (covering a partial course only). Degrees were issued beginning with the year 1913.

Abbot, Edward Moseley, II, '04 (D). Vice-President and Agent, Abbot Worsted Company, Graniteville, Mass.

Abbott, George Richard, II, '08 (D). Andover, Mass.

Adams, Floyd Willington, VI, '16 (B.T.E.). Superintendent, The Barrett Company, Peoria, Ill.

Adams, Henry Shaw, I, '05 (D). Secretary and Treasurer, The Springstein Mills, and Eureka Cotton Mills, Chester, S. C.

Adams, Tracy Addison, IV, '11 (D). Division Superintendent, Arnold Print Works, North Adams, Mass.

Albrecht, Charles Henry, IV, '17 (B.T.C.). Chemist, Wood Worsted Mills, Lawrence, Mass.

Almquist, George John Edwin, I, '19 (D). Manager, Passaic-Bergen Lumber Company, Ridgewood, N. J.

Anderson, Arthur Illman, IV, '24 (B.T.C.). Chemist, with R. G. Knowland, Chemical Engineer, 88 Broad Street, Boston, Mass.

Anderson, Arthur Julius, IV, '19 (B.T.C.). Salesman, National Aniline and Chemical Company, 40 Rector Street, New York City.

Anderson, Clarence Alfred, VI, '25 (B.T.E.). With Mohawk Carpet Mills, Inc., Amsterdam, N. Y.

Annan, David, II, '23 (D). With Quinapoxet Manufacturing Company, Quinapoxet, Mass.

Arienti, Peter Joseph, IV, '10 (D). Chief Chemist, Sayles Finishing Plants, Inc., Saylesville, R. I.

Arundale, Henry Barnes, II, '07 (D). Research and Inspection Department, United States Testing Company, Inc., 316 Hudson Street, New York City.

Atwood, Henry Jones, II, '23 (D). Designer and Assistant to Superintendent, Sutton's Mills, North Andover, Mass.

Avery, Charles Henry, II, '06 (D). Died January, 1913.

Babigan, Raymond, IV, '24 (B.T.C.). Junior Examiner, United States Patent Office, Washington, D. C.

Bachelder, Charles Edward, IV, '24 (B.T.C.). Dye Chemist, American Cellulose and Chemical Manufacturing Company, Ltd., Amcelle, Md.

Bailey, Joseph W., I, '99 (D). Agent, Butler Mill, New Bedford, Mass.

Bailey, Lester Harold, IV, '24 (B.T.C.). Textile Chemist, Pacific Mills, Lawrence, Mass.

Bailey, Walter James, IV, '11 (D). Bailey's Cleansers and Dyers, Watertown, Mass.

Baker, William John, IV, '16 (D).

Baldwin, Arthur Lincoln, IV, '00 (D). Died December 1, 1919.

Baldwin, Frederick Albert, II, '04 (D). Vice-President and Secretary, Walter Blue & Co., Ltd., Sherbrooke, Que.

Ballard, Horace W. C. S., IV, '08 (D). Died September 28, 1918.

Barlofsky, Archie, VI, '17 (B.T.E.). Merchant, Economy Cash Market, 165 Chelmsford Street, Lowell, Mass.

Barr, I. Walwin, I, '00 (D). With Buckley Brothers, 881 Broadway, New York City.

Barrett, Andrew Edward, IV, '23 (B.T.C.). With Uhlig Piece Dye Works, Haledon, N. J.

Beck, Frederic Christian, II, '24 (D). In business, Weld & Beck, Southbridge, Mass.

Bell, Edward Benjamin, IV, '24 (B.T.C.). With Craigleith Mills, Inc., Oakland, R. I.

Bennett, Edward Howard, II, '03 (C). Publisher, American Wool and Cotton Reporter, 530 Atlantic Avenue, Boston, Mass.

Bennett, Herbert Bowen, II, '13 (D). Died January 23, 1920.

Berry, Wilbur French, II, '17 (D). Manager and Treasurer, Wilbur Manufacturing Company, Providence, R. I.

Bienstock, George Jerrard, III, '24 (D). Designer, Davis Brothers Company, New York City.

Bigelow, Prescott Fenno, II, '12 (D). Died October 14, 1918.

Bird, Clarence Henry, II, '22 (D). Assistant Superintendent, Worcester Woolen Mill Company, Worcester, Mass.

Bird, Francis John, VI, '22 (B.T.E.). 30 West Street, Attleboro, Mass.

Blaikie, Howard Mills, II, '11 (D). Assistant Styler and Salesman, American Woolen Company, 225 4th Avenue, New York City.

Blake, Parker Gould, VI, '14 (D). Manufacturers' Agent, Claude Denis & Co., Toronto, Ont.

Blanchard, John Lawrence, II, '23 (D). With Pondicherry Woolen Company, Bridgton, Me.

Bloom, Wilfred Nathaniel, IV, '03 (D). Died August 17, 1918.

Bodwell, Henry Albert, II, '00 (D). Treasurer and General Manager, Smith & Dove Manufacturing Company, Andover, Mass.

Booth, James Mooney, IV, '24 (B.T.C.). Harvard Business School, Cambridge, Mass.

Boyd, George Andrew, I, '05 (D). Assistant Treasurer, Harmony Mills, Cohoes, N. Y.

Boylston, Theodore Willmott, IV, '21 (B.T.C.). Died June 3, 1921.

Brackett, Martin Richard, II, '22 (D). With D. S. Mackay & Co., 215 Fourth Avenue, New York City.

Bradford, Harold Palmer, II, '25 (D). 90 Beach Street, Malden, Mass.

Bradford, Roy Hosmer, II, '06 (D). Superintendent, Linen Thread Plant, Smith & Dove Manufacturing Company, Andover, Mass.

Bradley, Raymond Frost, VI, '14 (D). Garage Proprietor, Twin Light Garage Company, 267 East Main Street, Gloucester, Mass.

Bradley, Richard Henry, V, '01 (C). Overseer, Wamsutta Manufacturing Company, New Bedford, Mass.

Brainerd, Arthur Travena, IV, '09 (D). Salesman, General Dyestuff Corporation, 305 West Randolph Street, Chicago, Ill.

Brainerd, Carl Emil, IV, '20 (B.T.C.). Overseer of Dyeing, F. C. Huyck & Sons, Albany, N. Y.

Brainerd, Carroll Lewis, IV, '19 (B.T.C.). With Waldrich Bleachery, Delawanna, N. J.

Brandt, Carl Dewey, VI, '20 (B.T.E.). Assistant Superintendent and Chemist, Lowell Bleachery South, Experiment, Ga.

Brannen, Leon Vincent, III, '07 (C).

Brickett, Chauncy Jackson, II, '00 (D). Principal, School of Textiles, International Correspondence School, Scranton, Pa.

Brickett, Raymond Calvin, II, '14 (D). Overseer, M. T. Stevens & Sons Company (Marland Mills), Andover, Mass.

Brigham, Howard Mason, VI, '24 (B.T.E.). With Hunter Manufacturing and Commission Company, 60 Worth Street, New York City.

Brown, Gerald Marston, VI, '22 (B.T.E.). With Monomac Spinning Company, Lawrence, Mass.

Brown, Philip Franklin, II, '23 (D). Sales Department, DuPont Rayon Company, 132 Madison Avenue, New York City.

Brown, Rollins Goldthwaite, IV, '12 (D). Sales Representative, White Brothers, Inc., Winchendon Springs, Mass.

Brown, Russell Lee, VI, '21 (B.T.E.). Assistant Superintendent, M. T. Stevens & Sons Co., Franklin, N. H.

Brown, Will George, Jr., IV, '22 (B.T.C.). Chief Chemist, American Hide & Leather Company, Lowell, Mass.

Buchan, Donald Cameron, II, '01 (D). Assistant Superintendent, M. T. Stevens & Sons Company, North Andover, Mass.

Burbeck, Dorothy Maria, IV, '20 (B.T.C.). See Garlick, Mrs. Dorothy M.
Burger, Samuel Joseph, III, '24 (D).
Burnham, Frank Erwin, IV, '02 (D). Dyer and Chemist, Black River Mill, Ludlow, Vt.
Burrage, Katharine C., IIIb, '99 (C). Died May 16, 1914.

Cameron, Elliott Francis, IV, '11 (D). Treasurer, Amos F. Chase Company, Inc., 13 Otis Street, Boston, Mass.
Campbell, Alexander, VI, '23 (B.T.E.). Resident Engineer, John A. Stevens, Engineer, 904 Sun Building, Lowell, Mass.
Campbell, Laura Etta, IIIb, '00 (C). Deceased.
Campbell, Louise Porter, IIIb, '03 (C). With Ginn & Co., 15 Ashburton Place, Boston, Mass.
Campbell, Orison Sargent, II, '03 (D.). Superintendent, Canadian Consolidated Felt Company, Ltd., Kitchener, Ont.
Cannell, Philip Stuart, VI, '23 (B.T.E.). Engineer, John A. Stevens, 904 Sun Building, Lowell, Mass.
Carr, George Everett, I, '05 (D).
Carr, Paul Edward, II, '24 (D). 38 Glenwood Avenue, Cambridge, Mass.
Carter, Robert Albion, IV, '02 (D). Salesman, E. I. du Pont de Nemours & Co., 128 South Front Street, Philadelphia, Pa.
Carter, Russell Albert, II, '25 (D). With Mohawk Carpet Mills, Inc., Amsterdam, N. Y.
Cary, Julian Clinton, VI, '10 (D). Branch Manager, American Mutual Liability Insurance Company, 209 Pearl Street, Hartford, Conn.
Caya, Ferdinand Joseph, IV, '22 (B.T.C.). Textile Colorist, National Aniline and Chemical Company, Boston, Mass.
Chamberlin, Frederick Ellery, I, '03 (D). Overseer of Spinning, Monument Mills, Housatonic, Mass.
Chandler, Proctor Ralph, IV, '11 (D). President, Chandler Manufacturing Company, 28 Carleton Street, Cambridge, Mass.
Chang, Chi, VI, '23 (B.T.E.).
Chang, Wen Chuan, VI, '21 (B.T.E.). Dah Sung Cotton Mill No. 1, Nantung, Kiangsu, China.
Chapman, Leland Hildreth, VI, '24 (B.T.E.). Instructor, Brewster Academy, Wolfeboro, N. H.
Chen, Shih Ching, IV, '22 (B.T.C.). Hou Sung Cotton Mill, Shanghai, China.
Chen, Wen-Pei, IV, '24 (B.T.C.).
Chisholm, Lester Bury, I, '11 (D). Assistant General Manager, Everlastik, Inc., Chelsea, Mass.
Church, Charles Royal, II, '06 (C). 2130 McClellan Drive, West Los Angeles, Calif.
Churchill, Charles Whittier, III, '06 (D). Manager, Churchill Manufacturing Company, Inc., Lowell, Mass.
Clapp, Frank Austin, II, '04 (D). Selling Agent, South Bend Woolen Mills, Inc., 215 4th Avenue, New York City.
Clark, Earl William, IV, !18 (B.T.C.). Chemist, Kalmus, Comstock & Wescott, Inc., Niagara Falls, N. Y.
Clark, Thomas Talbot, II, '10 (D). Treasurer, Talbot Mills, North Billerica, Mass.
Clarke, George Dean, II, '21 (C). Dyer, Seaman & Cobb Thread Mills, Hopkinton, Mass.
Clayton, Harold Edmund, VI, '21 (B.T.E.). Superintendent, Bottum & Torrance Co., Bennington, Vt.
Cleary, Charles Joseph, II, '13 (D). Chief, Textile and Rubber Branch, Materials Section, United States Army Air Service, McCook Field, Dayton, Ohio.
Clement, David Scott, IV, '24 (B.T.C.). With Braemor Mills, Inc., Pascoag, R. I.
Clifford, Albert Chester, VI, '22 (B.T.E.). Credit Clerk, Standard Oil Company of New York, Park Square Building, Boston, Mass.

Experimental Dyeing Laboratory

Clogston, Raymond B., IV, '04 (D). Superintendent of Dyeing, Merrimack Manufacturing Company, Lowell, Mass.

Coan, Charles Bisbee, IV, '12 (D). Dye Demonstrator, Jennings & Co., 93 Broad Street, Boston, Mass.

Cohen, Arthur Edward, IV, '23 (B.T.C.).

Cohen, Raphael Edvab, IV, '25 (B.T.C.). With Gotham Silk Hosiery Company, New York City.

Colby, James Tracy, VI, '16 (D). Salesman, F. C. Huyck & Sons, Albany, N. Y.

Cole, Edward Earle, IV, '06 (D). Reporter, The Bradstreet Company, Boston, Mass.

Cole, James Thomas, II, '05 (D). Treasurer, Arlington Industries for the Blind, Arlington, Mass.

Collonan, Herbert Joseph, II, '22 (D). Assistant Designer, Beoli Mills, Fitchburg, Mass.

Coman, James Groesbeck, I, '07 (D). Superintendent, Mexia Textile Mills, Mexia, Texas.

Conant, Harold Wright, I, '09 (D). Treasurer and Manager, Conant, Houghton & Co., Inc., Littleton, Mass.

Conant, Richard Goldsmith, I, '12 (D). Executive, Wellington, Sears & Co., 93 Franklin Street, Boston, Mass.

Conklin, Jennie Grace, IIIb, '05 (C). See Nostrand, Mrs. William L.

Cook, Kenneth Bartlett, I, '13 (D). Manager, United States Rubber Company, Textile Section, Orange, N. J.

Cosendai, Edwin Frederick Ernest, IV, '15 (B.T.D.). Died November 1, 1923.

Craig, Albert Wood, IV, '07 (D). Superintendent, Windsor Print Works, North Adams, Mass.

Craig, Clarence Eugene, III, '02 (D). Board of Trade Building, 131 State Street, Boston, Mass.

Creese, Guy Talbot, IV, '14 (D). Chemist, Creese & Cook Company, Danversport, Mass.

Crowe, Joseph Bailey, IV, '25 (B.T.C.). Assistant Instructor, Lowell Textile School, Lowell, Mass.

Culver, Ralph Farnsworth, IV, '04 (D). Vice-President and Manager, Providence Office, Ciba Company, Inc., 61 Peck Street, Providence, R. I.

Cummings, Edward Stanton, VI, '16 (D). Cotton Tester, United States Department of Agriculture, Clemson College, S. C.

Curran, Charles Ernest, III, '02 (C). Head Designer, Wood Worsted Mills, Lawrence, Mass.

Currier, Herbert Augustus, I, '06 (D). Manager, New York Yarn Department, Wm. Whitman Company, Inc., 25 Madison Avenue, New York City.

Currier, John Alva, II, '01 (D). Superintendent, Pentucket Mills (M. T. Stevens & Sons Company), Haverhill, Mass.

Curtis, Frank Mitchell, I, '06 (D). Lumber Merchant, Wm. Curtis Sons Company, 30 Eustis Street, Roxbury, Mass.

Curtis, William Leavitt, II, '05 (C).

Cutler, Benjamin Winthrop, Jr., III, '04 (D).

Cuttle, James H., II, '99 (D).

Dalton, Gregory Smith, IV, '12 (D).

Datar, Anant Vithal, VI, '24 (B.T.E.). Inchalkaranji (S. M. Cy), India.

Davieau, Alfred Edward, VI, '16 (D). In charge of Textile Testing and Analysis, United States Testing Company, Inc., 316 Hudson Street, New York City.

Davieau, Arthur Napoleon, VI, '13 (D). Superintendent, Kenwood Mills, Ltd. (F. C. Huyck & Sons), Arnprior, Ont.

Davieau, Leon Arthur, VI, '23 (B.T.E.). With Pacific Mills, Lawrence, Mass.

Davis, Alexander Duncan, VI, '14 (B.T.E.). Instructor, Northeastern University, Springfield, Mass.

Dearborn, Roy, VI, '13 (D). Purchasing Agent, Brightwood Manufacturing Company, North Andover, Mass.

Dearth, Elmer Ellridge, IV, '12 (D). General Superintendent, Fisk Rubber Company, Federal Division, Cudahy, Wis.

DelPlaine, Parker Haywood, IV, '25 (B. T. C.). Chemist, Rohm & Haas Company, Bristol, Pa.

Derby, Roland Everett, IV, '22 (B.T.C.). Dyer, Lowell Dye Works, Lowell, Mass.

de Sa, Francisco, VI, '18 (B.T.E.). Avenue da Graca, Bahia, Brazil.

Dewey, James French, II, '04 (D). Vice-President and Superintendent, A. G. Dewey Company, Quechee, Vt.

Dewey, Maurice William, II, '11 (D). Inspector of Real Estate and Real Estate Loans, National Life Insurance Company, Montpelier, Vt.

Dillon, James Henry, III, '05 (D). Land Developing and Colonizing, 512 Summer Building, St. Petersburg, Fla.

Donald, Albert Edward, II, '04 (D). Agent, Hecla Mill (American Woolen Company), Uxbridge, Mass.

Donovan, Joseph Richard, IV, '24 (B.T.C.). With National Aniline & Chemical Co., Buffalo, N. Y.

Doran, Wilbur Kirkland, II, '22 (D). Teacher, Manchester High School, Manchester, N. H.

Dorr, Clinton Lamont, VI, '14 (D). Manager, Raymond Syndicate, 356 Washington Street, Boston, Mass.

Douglas, Walter Shelton, II, '21 (D). 12 Bertram Street, Lowell, Mass.

Duguid, Harry Wyatt, I, '24 (D). Assistant Superintendent, Maverick Mills, East Boston, Mass.

Dunnican, Edward Tunis, VI, '24 (B.T.E.). Second Hand, Pacific Mills, Lawrence, Mass.

Durgin, William Ernest, IV, '24 (B.T.C.). Textile Chemist, Geigy & Co., Inc., 88 Broad Street, Boston, Mass.

Duval, Joseph Edward, II, '10 (D). Yarn Dealer, 308 Chestnut Street, Philadelphia, Pa.

Dwight, John Francis, Jr., II, '08 (D). Proprietor, Humarock Inn, Humarock, Mass.

Echmalian, John Gregory, VI, '16 (B.T.E.). With Cheney Brothers, So. Manchester, Conn.

Ehrenfried, Jacob Benjamin, II, '07 (C). With George Ehrenfried Company, Lewiston, Me.

Elliot, Gordon Baylies, II, '12 (D). Production Work, Reed & Prince Manufacturing Company, Worcester, Mass.

Ellis, Charles Albert, VI, '21 (B.T.E.). In business, de Camp & Ellis, Ocala, Fla.

Ellis, Dorothy Mryta, VI, '25 (B.T.E.). Assistant to Employment Manager, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.

Emerson, Frank Warren, II, '03 (D). Agent, Standish Worsted Company, Penacook, N. H.

Engstrom, Karl Emil, VI, '12 (D). (S.B. 1916, Massachusetts Institute of Technology.) Salesman, E. B. Badger & Sons Co., 75 Pitts Street, Boston, Mass.

Enloe, Winfred Paige, I, '22 (D). Assistant Superintendent, W. A. Handley Manufacturing Company, Roanoke, Ala.

Evans, Alfred Whitney, III, '03 (D).

Evans, William Robinson, III, '03 (D). 309 Main Street, Bradford, Mass.

Everett, Charles Arthur, IV, '19 (B.T.C.). Instructor, Dyeing Department, Lowell Textile School, Lowell, Mass.

Ewer, Nathaniel Trull, IV, '01 (D). Chemist, American Dyewood Company, Chester, Pa.

Fairbanks, Almonte Harrison, II, '09 (D). Treasurer and Manager, Middlesex Knitting Company, Wakefield, Mass.

Farmer, Chester Jefferson, IV, '07 (D). Professor of Chemistry, Northwestern Medical School, Chicago, Ill.

Farnsworth, Harold Vincent, VI, '16 (B.T.E.). Sales Engineer, with Atkinson, Haserick & Co., 152 Congress Street, Boston, Mass.

Farr, Leonard Schaefar, II, '08 (D). Assistant Superintendent, No. 2 Mill, Farr Alpaca Company, Holyoke, Mass.

Farwell, Claude Chapman, VI, '23 (B.T.E.). Groton, Mass.

Farwell, Ray Baldwin, VI, '24 (B.T.E.). Master Mechanic, Belmont Hosiery Company, Belmont, N. H.

Feindel, George Paul, IV, '24 (B.T.C.). Overseer of Dyeing, Burson Knitting Company, Rockford, Ill.

Feldstein, Martin Alexander, VI, '24 (B.T.E.). Production Manager, Amplex Instrument Laboratories, 88 West Broadway, New York City.

Fels, August Benedict, II, '99 (D).

Ferguson, Arthur Feiling, I, '03 (D). With United States Tariff Commission, Washington, D. C.

Ferguson, William Gladstone, III, '09 (D). Manager, Efficiency Department, Ludlow Manufacturing Associates, Ludlow, Mass.

Finlay, Harry Francis, IV, '10 (D). Color Chemist, National Aniline and Chemical Company, Boston, Mass.

Fisher, Russell Todd, VI, '14 (D)., '25 (B.T.E.). Acting Secretary, National Association of Cotton Manufacturers, 80 Federal Street, Boston, Mass.

Fiske, Starr Hollinger, II, '09 (D). Superintendent, Wachusett Mills and E. J. Hylan Textile Company, Lowell, Mass.

Fitzgerald, John Francis, IV, '18 (B.T.C.). Dyer, Boston Dye House, Malden, Mass.

Fleischmann, Meyer, IV, '20 (B.T.C.). Chief Chemist, Real Silk Hosiery Mills, Indianapolis, Ind.

Fleming, Frank Everett, IV, '06 (D). Assistant Dyer and Finisher, Goodall Worsted Company, Sanford, Me.

Fletcher, Howard Varnum, III, '25 (D). With North Billerica Company, North Billerica, Mass.

Fletcher, Roland Hartwell, VI, '10 (D). With Pressed Steel Car Company, McKees Rocks, Pa.

Flynn, Thomas Patrick, IV, '11 (D). Salesman, American Aniline Products, Inc., 77 Bedford Street, Boston, Mass.

Ford, Edgar Robinson, IV, '11 (D). Finisher, Sayles Finishing Plants, Saylesville, R. I.

Forsaith, Charles Henry, VI, '20 (B.T.E.). Superintendent, Nashua Manufacturing Company (Jackson Mills), Nashua, N. H.

Forsaith, Ralph Allen, VI, '16 (B.T.E.). Assistant Superintendent, Appleton Company, Lowell, Mass.

Forsyth, Harold Downes, VI, '23 (B.T.E.). Secretary of the Corporation, Wm. Forsyth & Sons Co., Lynn, Mass.

Foster, Boutwell Hyde, VI, '17 (B.T.E.). Textile Engineer, Textile Section, United States Rubber Company, 451 South Jefferson Street, Orange, N. J.

Foster, Clifford Eastman, II, '01 (D). Salesman, Wickwire Spencer Steel Company, 41 East 42nd Street, New York City.

Fowle, Edwin Daniels, VI, '24 (B.T.E.). Editorial Department, "Textile World," 65 Franklin Street, Boston, Mass.

Frost, Harold Benjamin, II, '12 (D). With Hadley Wool Company, Inc., 170 Summer Street, Boston, Mass.

Fuller, Allen Reed, IV, '17 (B.T.C.). Chemist, Bliss, Fabyan Company, Three Rivers, Mass.

Fuller, George, I, '03 (D). Assistant to the President, Riverside & Dan River Cotton Mills, Inc., Danville, Va.

Gadsby, Arthur Norton, II, '13 (D). Worsted Employment Manager, Pacific Mills, Lawrence, Mass.

Gahm, George Leonhard, II, '06 (D). Superintendent, Yarn Department, Wood Worsted Mills, Lawrence, Mass.

Gainey, Francis William, IV, '11 (D). Colorist, E. I. du Pont de Nemours & Co., Wilmington, Dela.

Gale, Harry Laburton, III, '10 (D). Manager, Styling and Designing Department, Hunter Manufacturing and Commission Company, 58 Worth Street, New York City.

Garlick, Mrs. Dorothy M. (Burbeck, Dorothy M.), IV, '20 (B.T.C.). Chemist, Arlington Mills, Lawrence, Mass.

Gay, Olin Dow, II, '08 (D). Superintendent of Woolen Mill, Gay Brothers Company, Cavendish, Vt.

Gerrish, Henry Kilborn, III, '16 (D). Died September 18, 1922.

Gerrish, Walter, III, '03 (D). Director of Occupational Therapy, Devereaux Mansion, Inc., Marblehead, Mass.

Gillie, Stanley James, I, '22 (D). With United States Testing Company, Inc., New York City.

Gillon, Sara Agnes, IIIb, '06 (C).

Goldberg, George, VI, '10 (D). Manufacturer, Liberty Lace and Braid Company, 88 Bedford Street, Boston, Mass.

Goldman, Moses Hyman, IV, '20 (B.T.C.). Research Chemist, National Association of Dyers and Cleaners of United States and Textile Section of Canada, Bureau of Standards, Washington, D. C.

Goller, Harold Poehlmann, II, '23 (D). Salesman, du Pont Rayon Company, Woodside Building, Greenville, S. C.

Goodhue, Amy Helen, IIIb, '00 (C). See Harrison, Mrs. Arthur.

Gooding, Francis Earle, IV, '19 (B.T.C.). Night Superintendent, Chipman Chemical Engineering Company, Bound Brook, N. J.

Goosetrey, Arthur, IV, '21 (B.T.C.). Overseer of Dyeing, Keene Silk Fibre Mills, Keene, N. H.

Goosetrey, John Thomas, IV, '21 (B.T.C.). Dyer and Chemist, Rhode Island Lace Company, West Barrington, R. I.

Gould, Norman Culver, VI, '19 (B.T.E.). Textile Engineer, F. C. Huyck & Sons, Albany, N. Y.

Greenberg, Archie, II, '21 (D). Linenfoot Hosiery Company, Philadelphia, Pa.

Gwinnell, George Harry, II, '25 (D). Assistant Designer, Pontoosuc Woolen Company, Pittsfield, Mass.

Gyzander, Arne Kolthoff, IV, '09 (D). Chemist, National Aniline and Chemical Company, 113 High Street, Boston, Mass.

Haddad, Nassib, VI, '23 (B.T.E.). Time Study Clerk, International Motor Company, New Brunswick, N. J.

Hadley, Richard Francis, IV, '22 (B.T.C.). Salesman, Carbon, Coal & Coke Company, 85 Devonshire Street, Boston, Mass.

Hadley, Walter Eastman, IV, '08 (D). Chief Chemist, The Clark Thread Company, Newark, N. J.

Hadley, Wilfred Nourse, II, '22 (D). With Parks & Woolson Company, Springfield, Vt.

Hager, Hazen Otis, II, '21 (C).

Hall, Frederick Kilby, VI, '24 (B.T.E.). With National Association of Cotton Manufacturers, 80 Federal Street, Boston, Mass.

Halsell, Elam Ryan, I, '04 (C).

Hammond, Chester Twombly, II, '23 (D). Assistant to Wool Buyer, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.

Hardie, Newton Gary, I, '23 (D). Assistant Superintendent, Stonecutter Mills Company, Inc., Spindale, N. C.

Hardy, Philip Lewis, VI, '10 (D). Contractor, Andover, Mass.

Harmon, Charles Francis, I, '99 (D). 86 Kingsland Avenue, Elmhurst, L. I.

Harrington, Thomas, IV, '15 (D). Superintendent, Monarch Leather Company, 1127 West Division Street, Chicago, Ill.

Harris, Charles Edward, I, '05 (D). General Manager, The Harris Company, Easthampton, Mass.

Harris, George Simmons, I, '02 (C). President and Manager, Exposition Cotton Mills, Atlanta, Ga.

Harrison, Mrs. Arthur (Goodhue, Amy Helen), IIIb, '00 (C). R. F. D. No. 2, Lowell, Mass.

Hart, Arthur Norman, IV, '19 (B.T.C.). Chemist, Crystal Analysis Company, Chicago, Ill.

Hart, Howard Roscoe, I, '23 (D). With Stonecutter Mills Company, Inc., Spindale, N. C.

Haskell, Spencer Howard, II, '07 (D). Deceased.

Haskell, Walter Frank, IV, '02 (D). Overseer of Dyeing, Dana Warp Mills, Westbrook, Me.

Hassett, Paul Joseph, IV, '12 (D). With E. S. Twining & Co., 93 Worth Street, New York City.

Hathorn, George Wilmer, IV, '07 (D). Chemist, Lawrence Gas Company, Lawrence, Mass.

Hathorne, Berkeley Lewis, IV, '24 (B.T.C.). Boss Dyer, Pitman Manufacturing Company, Laconia, N. H.

Hay, Ernest Crawford, II, '11 (D). Superintendent, Monomac Spinning Company, Lawrence, Mass.

Hendrickson, Walter Alexander, II, '11 (D). With National Knitting Company, 905 Clinton Street, Milwaukee, Wis.

Hennigan, Arthur Joseph, II, '06 (D). President, Seneca Manufacturing Company, and New England Representative, Cox & Schreiber, of New York, 31 Bedford Street, Boston, Mass.

Hibbard, Frederick William, IV, '25 (B.T.C.) Chemist, Appleton Company, Lowell, Mass.

Hildreth, Harold William, II, '07 (D). Granite Dealer, Westford, Mass.

Hillman, Ralph Greeley, VI, '22 (B.T.E.). Assistant Superintendent, Samson Cordage Works, Shirley, Mass.

Hindle, Milton, VI, '25 (B.T.E.). Textile Engineer, F. C. Huyck & Sons, Albany, N. Y.

Hintze, Thomas Forsyth, I, '06 (C).

Hodge, Harold Bradley, VI, '22 (B.T.E.). With J. C. and W. T. Monahan, Civil Engineers and Surveyors, 219 Central Street, Lowell, Mass.

Hoffman, Richard Robert, II, '21 (C). Assistant Designer, Beoli Mills, Fitchburg, Mass.

Holden, Francis Crawford, IV, '09 (D). Chemist, Chelsea Fibre Mills, 1155 Manhattan Avenue, Brooklyn, N. Y.

Holden, John Sanford, II, '20 (D). Manufacturer, Automatic Machine Products' Company, Attleboro, Mass.

Holgate, Benjamin, III, '02 (C). Agent, Boott Mills, Lowell, Mass.

Hollings, James Louis, I, '05 (D). Buyer and Converter (Cotton Goods), W. R. Grace & Co., 7 Hanover Square, New York City.

Hollstein, William Diedrick, VI, '25 (B.T.E.). In Purchasing Department, S. Stein & Company, 216 Fifth Avenue, New York City.

Holmes, Otis Milton, VI, '13 (B.T.E.). Draftsman, United Shoe Machinery Corporation, Beverly, Mass.

Hood, Leslie Newton, IV, '12 (D). Chemist, Union Bleachery, Greenville, S. C.

Hook, Russell Weeks, IV, '05 (D). Chemist in charge of Textile Department, Arthur D. Little, Inc., 30 Charles River Road, Cambridge, Mass.

Horne, James Albert, I, '24 (D). With Carl Stohn, Inc., Hyde Park, Mass.

Horsfall, George Gordon, II, '04 (C). Assistant Dyer, Interwoven Mills, Inc., Martinsburg, W. Va.

Horton, Chester Temple, VI, '14 (B.T.E.). Wilmington, Mass.

Houghton, Robert Kingsbury, IV, '23 (B.T.C.). Assistant Chemist, Bradford Dyeing Association, Bradford, R. I.

Howarth, Charles Lincoln, IV, '17 (B.T.C.) Assistant Professor of Dyeing, Lowell Textile School, Lowell, Mass.

Howe, Woodbury Kendall, I, '10 (D). Assistant Superintendent, Merrimack Manufacturing Company, Lowell, Mass.

Hoyt, Charles William Henry, IV, '07 (D).

Hsu, Hsueh-Chang, VI, '23 (B.T.E.).

Hubbard, Harold Harper, I, '22 (D). Overseer, Royal River Manufacturing Company, Yarmouth, Me.

Hubbard, Ralph King, IV, '11 (D). Treasurer and Manager, Packard Mills, Inc., Webster, Mass.
Huising, Gerónimo Huerva, I, '08 (D). With San Augustin Plantation Company, San José, Mindoro, P. I.
Hunt, Chester Lansing, III, '05 (C).
Hunton, John Horace, II, '11 (D). Treasurer and General Manager, Newichawanick Company, South Berwick, Me.
Hurtado, Leopoldo, Jr., VI, '10 (D). General Manager, Hurtado & Co., Uruapan, Michoacán, Mex.
Hurwitz, Jacob, IV, '23 (B.T.C.).
Hutton, Clarence, III, '03 (C). Editor, "Textile World," 65 Franklin Street, Boston, Mass.

Irvine, James Andrew, VI, '17 (B.T.E.). Educational Director, Cheney Brothers, South Manchester, Conn.

Jaeger, Robert William, Jr., IV, '23 (B.T.C.). In charge of Scouring Plant, James & E. H. Wilson, Inc., (Taconic Woolen Mill), Pittsfield, Mass.
Jelleme, William Oscar, I, '10 (D). With Cohn-Hall-Marx Company, 93 Franklin Street, New York City.
Jen, Shang Wu, I, '21 (D).
Jenckes, Leland Aldrich, VI, '08 (D). Deceased.
Jessop, Charles Clifford, VI, '22 (B.T.E.). Efficiency and Safety Engineer, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.
Johnson, Arthur Kimball, IV, '13 (D) (S.B. 1917, Massachusetts Institute of Technology). Instructor in Chemistry, Lowell Textile School, Lowell, Mass.
Johnson, George Henry, IV, '20 (B.T.C.). Director of Research, Mellon Institute, University of Pittsburgh, Pittsburgh, Pa.
Johnson, Philip Stanley, IV, '24 (B.T.C.). Advertising Manager, Clearwater Sun, Clearwater, Fla.
Jones, Everett Amos, III, '05 (D). Superintendent and Secretary, Nye & Wait Kilmarnock Corporation, Auburn, N. Y.
Jones, Nathaniel Erskine, I, '21 (D). 213 High Street, Newburyport, Mass.
Jury, Alfred Elmer, IV, '04 (D). Director, General Laboratories, United States Rubber Company, 561 West 58th Street, New York City.

Kaatze, Julius, VI, '22 (B.T.E.). Salesman, Toledo Scale Company, Lawrence, Mass.
Kao, Chieh-Ching, VI, '23 (B.T.E.).
Karanfilian, John Hagop, VI, '21 (B.T.E.). 5508 Chester Avenue, West Philadelphia, Pa.
Kay, Harry Pearson, II, '09 (D). New England Agent, S. Slater & Sons, Inc., 115 Chauncy Street, Boston, Mass.
Kendall, Charles Henry, II, '23 (D). Superintendent, Bridgewater Woolen Company, Bridgewater, Vt.
Kent, Clarence LeBaron, III, '06 (C). Manager, Standard Oil Company, Rochester, N. H.
Keough, Wesley Lincoln, II, '10 (D). With A. A. Housman-Guatmey & Co., Pasadena, Calif.
Kingsbury, Percey Fox, IV, '01 (D). Print Manager, Passaic Print Works, Passaic, N. J.
Knowland, Daniel Power, IV, '07 (D). Chemist, Geigy Company, Inc., 89 Barclay Street, New York City.
Knox, Joseph Carleton, VI, '23 (B.T.E.). Assistant Foreman, Insulating Department, Simplex Wire and Cable Company, East Cambridge, Mass.

Lakeman, Fannie Shillaber, IIIb, '00 (C). Died February 8, 1921.
Lamb, Arthur Franklin, II, '10 (D). In business, cleansing and dyeing, 297 Main Street, Rockland, Me.
Lamont, Robert Laurence, II, '12 (D).
Lamprey, Leslie Balch, IV, '16 (B.T.D.). 173 Parker Street, Lawrence, Mass.

Lamson, George Francis, I, '00 (D). With Ludlow Manufacturing Associates, Ludlow, Mass.

Lane, John William, I, '06 (C).

Lane, Oliver Fellows, IV, '15 (B.T.D.). Chemist, Head of Color Making Department, Lowe Paper Company, Ridgefield, N. J.

Larratt, John Francis, II, '22 (D). Assistant Overseer, Kinney Worsted Yarn Company, Pittsfield, Mass.

Laughlin, James Knowlton, III, '09 (D).

Laurin, Eric Thursten Lawrence, IV, '21 (B.T.C.). Textile Chemist and Colorist, Sayles Finishing Plant, Saylesville, R. I.

Laurin, Sven Albert, IV, '23 (B.T.C.). Assistant Colorist, Fiberloid Corporation, Indian Orchard, Mass.

Leach, John Pelopidas, I, '00 (C). Farming, Littleton, N. C.

Lee, William Henry, II, '05 (C). Treasurer, Lee's Wool Shop, 207 Pine Street, Holyoke, Mass.

Leitch, Harold Watson, IV, '14 (B.T.D.). Chemical Engineer, M. T. Stevens & Sons Co., Franklin, N. H.

Lemire, Joseph Emile, VI, '21 (B.T.E.). In Real Estate Business, Lowell, Mass.

Levi, Alfred Sandel, IV, '09 (D). Vice-President and Secretary, Liondale Bleach, Dye and Print Works, Rockaway, N. J.

Lewis, George Kenneth, VI, '24 (B.T.E.). Overseer, Jackson Mills (Nashua Manufacturing Company), Nashua, N. H.

Lewis, LeRoy Clark, IV, '08 (D). Representative, Neutrasol Products Corporation, 41 Park Row, New York City.

Lewis, Walter Scott, IV, '05 (D). Special Expert in Textiles, United States Tariff Commission, Washington, D. C.

Lillis, Marvin Hale, IV, '14 (D). With Marland Mills, Andover, Mass.

Linsey, Edward, II, '25 (D). Assistant Foreman, Mohawk Carpet Mills, Inc. Amsterdam, N. Y.

Lombard, Carleton Joshua, VI, '23 (B.T.E.). With Curtis & Marble Machine Company, Worcester, Mass.

Loney, Robert William, II, '22 (D). Foreman, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.

Longbottom, Parker Wyman, IV, '21 (B.T.C.). Chemist, Watson Park Company, 165 High Street, Boston, Mass.

Lowe, Philip Russell, VI, '24 (B.T.E.). With Smith & Dove Manufacturing Company, Andover, Mass.

Lucey, Edmund Ambrose, II, '04 (D). President, Wm. A. Tottle & Co., Inc., Baltimore, Md.

McCann, John Joseph, Jr., VI, '24 (B.T.E.).

McCool, Frank Leslie, IV, '10 (D). Vice-President, S. R. David & Co., Inc., 252 Congress Street, Boston, Mass.

Macdonald, Hector Graham, IV, '19 (B.T.C.). Chemist, Franklin Process Company, Providence, R. I.

McDonnell, William Henry, I, '06 (C). Lawyer, McDonnell & White, 40 Court Street, Boston, Mass.

McGowan, Frank Robert, VI, '15 (B T.E.). Textile Engineer, 1009 Hill Building, Washington, D. C.

McGowan, Henry Earl, VI, '22 (B.T.E.). Instructor, Lowell High School, Lowell, Mass.

Mackay, Stewart, III, '07 (D). Assistant Professor of Textile Design, Lowell Textile School, Lowell, Mass.

McKenna, Hugh Francis, IV, '05 (D). Manager, United Indigo and Chemical Company, Ltd., 218 West Kinzie Street, Chicago, Ill.

McKinstry, James Bradley, II, '25 (D). Assistant Superintendent, Cordaville Woolen Company, Cordaville, Mass.

MacPherson, Wallace Angus, III, '04 (D). Designer, Wuskanut Mills, Inc., (S. Slater & Sons), Farnumsville, Mass.

Macher, Henry, II, '23 (D). Industrial Research Work, Garfield Worsted Mills, Garfield, N. J.

Mahoney, George Stephen, VI, '22 (B.T.E.). With the Franklin Cotton Mill Company, Cincinnati, Ohio.

Mailey, Howard Twisden, II, '08 (D). Assistant Superintendent, Worsted Department, Pacific Mills, Lawrence, Mass.

Manning, Frederick David, IV, '10 (D). Planning Department, Pacific Print Works, Lawrence, Mass.

Marcoglou, Aristides Sawa, VI, '22 (B.T.E.). 15 Abdine Street, Cairo, Egypt.

Marinel, Walter Newton, I, '01 (D). Automobile Repairing, North Chelmsford, Mass.

Marshall, Chester Stanley, II, '22 (D). Salesman, Dupont Rayon Company, 31 North 6th Street, Reading, Pa.

Martin, Harry Warren, IV, '11 (D). Divisional Manager, Hood Rubber Company, Watertown, Mass.

Mason, Archibald Lee, VI, '09 (D).

Mather, Harold Thomas, VI, '13 (D). Salesman, Russell Mills, 52 Chauncy Street, Boston, Mass.

Mathieu, Alfred Jules, II, '20 (D). Superintendent of Combing, French Worsted Company, Woonsocket, R. I.

Matthews, Elmer Clark, II, '17 (D). Superintendent, Thermo Mills, Inc., West Sand Lake, N. Y.

Mauersberger, Herbert Richard Carl, III, '18 (D). With James W. Cox, Jr., Textile Engineer, 320 Broadway, New York City.

Meadows, William Ransom, I, '04 (D). Cotton Registrar and Member of Chicago Board of Trade, 141 West Jackson Boulevard, Chicago, Ill.

Meek, Lotta, IIIb, '07 (C). See Parker, Mrs. Herbert L.

Merchant, Edith Clara, IIIb, '00 (C). Supervisor of Drawing, Lowell, Mass.

Merrill, Allan Blanchard, IV, '11 (D). Development Engineer, B. F. Goodrich Rubber Company, Akron, Ohio.

Merrill, Gilbert Roscoe, VI, '19 (B.T.E.). Assistant Professor of Textiles, Lowell Textile School, Lowell, Mass.

Merriman, Earl Cushing, II, '07 (D). Died September 30, 1918.

Midwood, Arnold Joseph, IV, '05 (D). Salesman, Dyestuffs Corporation of America, 281 Franklin Street, Boston, Mass.

Miller, Joshua, VI, '24 (B.T.E.). Assistant Technologist, Bureau of Standards, Washington, D. C.

Minge, Jackson Chadwick, I, '01 (C). Treasurer, M. K. Gray, Inc., 424 West 33d Street, New York City.

Mirsky, Leon Robert, II, '19 (D). Cloth Inspector, Navy Supply Depot, Brooklyn, N. Y.

Mitchell, Charles Alvah, II, '24 (D). In Wool House, New England Dressed Meat and Wool Co., Somerville, Mass.

Moller, Ernest Arthur, II, '22 (D). Salesman, the Flintkote Company, 809 Park Square Building, Boston, Mass.

Molloy, Francis Henry, II, '16 (D). Assistant Designer, Assabet Mill (American Woolen Company), Maynard, Mass.

Moore, Edward Francis, II, '25 (D). Foreman, Rockford Mitten and Hosiery Company, Rockford, Ill.

Moore, Everett Byron, I, '05 (D). President and Assistant Treasurer, Chadbourne & Moore, Inc., Chelsea, Mass.

Moore, Karl Remick, IV, '11 (D). Chemical Engineer, Stillwater Worsted Mills, Harrisville, R. I.

Moore, William Joseph, IV, '21 (B.T.C.) Chemist, Pacific Mills, Lawrence, Mass.

Moorhouse, William Roy, IV, '01 (D). Manager, Domestic Sales, National Aniline and Chemical Company, Inc., 113 High Street, Boston, Mass.

Morrill, Howard Andrew, VI, '16 (D). Assistant Agent, Pepperell Manufacturing Company, Biddeford, Me.

Morris, Merrill George, IV, '21 (B.T.C.). Overseer of Dyeing, Nassau Felt Mills, Brooklyn, N. Y.

Morrison, Fred Clifton, I, '03 (D). Died August 21, 1919.

Morrison, Haven Asa, IV, '25 (B.T.C.). Colorist, National Aniline and Chemical Company, 113 High Street, Boston, Mass.

Finishing Department

Mullaney, John Francis, VI, '20 (B.T.E.). With Saco-Lowell Shops, Lowell, Mass.

Mullen, Arthur Thomas, II, '09 (D). Superintendent, Mayo Woolen Mills Company, Millbury, Mass.

Munroe, Sydney Philip, I, '12 (D). Southern Manager, Ralph E. Loper & Co., Greenville, S. C.

Murray, James, IV, '13 (D). Chief Chemist, Appleton Coated Paper Company, Appleton, Wis.

Murray, James Andrew, II, '10 (D). With H. P. Murray Company, Inc., 144 Commercial Street, Boston, Mass.

Najar, G. George, IV, '03 (D). Overseer of Dyeing, Monument Mills, Housatonic, Mass.

Nary, James Anthony, II, '22 (D). Assistant Fabric Expert, United States Testing Company, New York City.

Nelson, Roy Clayton, II, '21 (C). Designer, Assabet Mills, Maynard, Mass.

Nelson, Russell Sprague, VI, '22 (B.T.E.). With Draper Corporation, Hopedale, Mass.

Neugroschl, Sigmond Israel, I, '21 (D). Furniture Dealer, Western Furniture Company, 874 South Vermont Avenue, Los Angeles, Calif.

Newall, John Douglas, IV, '09 (D). Division Superintendent, Arnold Print Works, North Adams, Mass.

Newcomb, Guy Houghton, IV, '06 (C). Assistant Manager, Dyestuff Department, E. I. du Pont de Nemours & Co., 1114 Union Trust Building, Chicago, Ill.

Neyman, Julius Ellis, IV, '15 (B.T.D.) Furniture Dealer, Neyman Furniture Company, 197–199 Middlesex Street, Lowell, Mass.

Nichols, Raymond Elmore, VI, '10 (D). With H. E. Fletcher Company, West Chelmsford, Mass.

Niven, Robert Scott, VI, '12 (D). Draftsman, General Electric Company, Lynn, Mass.

Nostrand, Mrs. William L. (Conklin, Jennie Grace), IIIb, '05 (C). 35 87th Street, Bay Ridge, Brooklyn, N. Y.

O'Brien, Philip Francis, II, '15 (D). Instructor, New York Textile High School, New York City.

O'Connell, Clarence Edward, IV, '11 (D). Dyer, National Aniline and Chemical Company, Buffalo, N. Y.

O'Connor, Lawrence Dennis, VI, '17 (D). With Beggs & Cobb, Winchester, Mass.

O'Donnell, John Delaney, I, '04 (C).

O'Hara, Williams Francis, IV, '04 (C). Superintendent, National Oil Products Company, Harrison, N. J.

Olson, Carl Oscar, II, '24 (D). With Talbot Mills, North Billerica, Mass.

Orr, Andrew Stewart, IV, '22 (B.T.C.). With Cherry & Webb, Lowell, Mass.

Othote, Louis Joseph, I, '23 (D.) Head Designer, T. Holt Haywood, 65 Leonard Street, New York City.

Palais, Samuel, IV, '18 (B.T.C.). Assistant Manager, Durrel Company, 1 Beacon Street, Boston, Mass.

Parker, B. Moore, I, '01 (D). Died December 11, 1918.

Parker, Everett Nichols, I, '05 (D). President, Parker Spool and Bobbin Company, 27–53 Middle Street, Lewiston, Me.

Parker, Harry Carmi, III, '00 (C). 144 Berkeley Street, Boston, Mass.

Parker, Mrs. Herbert L. (Meek, Lotta L.), IIIb, '07 (C). 4 Brookside Circle, Auburn, Me.

Parker, Hubert Frederic, VI, '20 (B.T.E.). Assistant to Consulting Engineer, John A. Stevens, Engineer, 904 Sun Building, Lowell, Mass.

Parkis, William Lawton, I, '09 (D). Investigator, Cheney Brothers, South Manchester, Conn.

Peabody, Roger Merrill, II, '16 (D). Textile Superintendent, Industrial Fiber Company, Cleveland, Ohio.

Pearson, Alfred Henry, IV, '11 (D). Salesman, Ciba Company, Inc., 93 Broad Street, Boston, Mass.

Pease, Chester Chapin, I, '09 (D). Superintendent, Columbian Manufacturing Company, Greenville, N. H.

Peck, Carroll Wilmot, IV, '13 (D). With George Mann & Co., Inc., 251 Tockwotton Street, Providence, R. I.

Pensel, George Robert, IV, '13 (B.T.D.). Vice-President, Ritter Chemical Company, Inc., Amsterdam, N. Y.

Perkins, John Edward, III, '00 (D). Superintendent, S. N. & C. Russell Manufacturing Company, Pittsfield, Mass.

Perkins, Joshua Dean, III, '08 (D). Overseer, Amoskeag Manufacturing Company, Manchester, N. H.

Perlman, Samuel, IV, '17 (B.T.C.).

Perlmuter, Barney Harold, IV, '23 (B.T.C.). Credit Manager, American Furniture Company, Boston, Mass.

Petty, George Edward, I, '03 (C). With Jefferson Standard Insurance Company, Greensboro, N. C.

Phaneuf, Maurice Philippe, III, '20 (D). Draftsman, S. Belanger & Son, Inc., Nashua, N. H.

Pierce, George Whitwell, IV, '25 (B.T.C.). Chemist, American Cellulose and Chemical Company, Cumberland, Md.

Pillsbury, Ray Charles, I, '13 (D). Superintendent of Weaving, Cheney Brothers, South Manchester, Conn.

Plaisted, Webster E., II, '18 (D). Superintendent, John and James Dobson. Inc., Philadelphia, Pa.

Plummer, Elliot Barton, IV, '13 (D). Died January 14, 1919.

Potter, Carl Howard, I, '09 (D). Resident Manager, Green River Manufacturing Company, Tuxedo, N. C.

Pottinger, James Gilbert, II, '12 (D). Piece Goods Buyer, Reliance Manufacturing Company, 212 West Monroe Street, Chicago, Ill.

Powers, Walter Wellington, IV, '20 (B.T.C.). Color Chemist, Fiberloid Corporation, Indian Orchard, Mass.

Pradel, Alois Joseph, III, '00 (D). Designer, Killingly Worsted Company, Danielson, Conn.

Pradel, Mrs. Alois J. (Walker, Anna G.), IIIb. '03 (C). 78 Broad Street, Danielson, Conn.

Precourt, Joseph Octave, VI, '21 (B.T.E.). Western Sales Manager, Cayuga Linen and Cotton Mills, Inc., 437 West Ontario Street, Chicago, Ill.

Prescott, Walker Flanders, IV, '09 (D). Manager, Prescott & Co., 326 St. James Street, Montreal, Can.

Prince, Sylvanus Cushing, VI, '08 (D).

Proctor, Braman, IV, '08 (D). With General Dyestuff Corporation, 159 High Street, Boston, Mass.

Putnam, George Ives, IV, '16 (B.T.D.). Chemist, McLoughlin Textile Corporation, Utica, N. Y.

Putnam, Leverett Nelson, IV, '10 (D). Overseer of Dyeing, Arlington Mills, Lawrence, Mass.

Putnam, Philip Clayton, IV, '13 (D). Foreman Dyer, Apponaug Company, Apponaug, R. I.

Quinlan, William Harold, VI, '20 (B.T.E.). Research Assistant, Warren Brothers Company, 32 Potter Street, Cambridge, Mass.

Radford, Garland, II, '20 (D). Manufacturer, Oriental Textile Mills, Houston, Tex.

Ramsdell, Theodore Ellis, I, '02 (D). Agent, Monument Mills, Housatonic, Mass.

Rasche, William August, III, '03 (D). Deceased.

Raymond, Charles Abel, IV, '07 (D). President, A-R-E Farm, Ltd., Challis, Idaho.

Reed, Norman Bagnell, I, '10 (D). General Superintendent, Lawrence Manufacturing Company, Lowell, Mass.

Reynolds, Fred Bartlett, II, '08 (D). Purchasing Agent, M. T. Stevens & Sons, Company, North Andover, Mass.

Reynolds, Isabel Halliday, III, '03 (C). Clerk, Pacific Mills Print Works, Lawrence, Mass.

Reynolds, Raymond, II, '24 (D). With Silesia Mills, North Chelmsford, Mass.

Rice, Josiah Alfred, Jr., III, '20 (D). Assistant Manager and Buyer, Marshall Field & Co., Chicago, Ill.

Rich, Edward, IV, '15 (B.T.D.). President, Jackson Caldwell Company, East Boston, Mass.

Rich, Everett Blaine, III, '11 (D). Brae Burn Country Club, West Newton, Mass.

Rich, Milton Scott, II, '22 (D). With Riverina Mills, Medford Hillside, Mass.

Richardon, George Oliver, IV, '16 (B.T.D.). Assistant Manager for China, National Aniline and Chemical Company, Inc., Shanghai, China.

Richardson, Richardson Perry, I, '13 (D). Salesman, H. F. Livermore Company, Boston, Mass.

Riggs, Homer Chase, VI, '17 (B.T.E.). With Rodney Hunt Machine Company, Orange, Mass.

Ripley, George Keyes, II, '17 (D). Superintendent, Troy Blanket Mills, Troy, N. H.

Rivers, William Anthony, II, '24 (D). Assistant Superintendent, Nantanna Worsted Company, Northfield, Vt.

Roberson, Pat Howell, I, '05 (C). Merchant, James R. Roberson & Sons, Cropwell, Ala.

Roberts, Carrie Isabel, IIIb, '05 (C). Craft Work, 37 Grace Street, Lowell, Mass.

Robinson, Ernest Warren, IV, '08 (D). Superintendent, Belding Brothers & Co., Rockville, Conn.

Robinson, Russell, VI, '21 (B.T.E.). Assistant Textile Superintendent, American Cellulose and Chemical Manufacturing Company, Ltd., Cumberland, Md.

Robinson, William Albert, II, '25 (D). With Chelsea Fibre Mills, 1155 Manhattan Avenue, Brooklyn, N. Y.

Robinson, William Carleton, III, '03 (C). With American Wool and Cotton Reporter, 530 Atlantic Avenue, Boston, Mass.

Robson, Frederick William Charles, IV, '10 (D).

Roche, Raymond Vincent, IV, '12 (D). With National Aniline and Chemical Company, Buffalo, N. Y.

Royal, Louis Merry, VI, '21 (B.T.E.). Teaching, Pepperell, Mass.

Rundlett, Arnold Dearborn, VI, '12 (D). Superintendent, Joseph Noone's Sons Company, Peterborough, N. H.

Runnells, Harold Nelson, IV, '25 (B.T.C.). Textile Chemist, Thermo Mills, West Sand Lake, N. Y.

Russell, John William, IV, '20 (B.T.C.). Chief Chemist, United States Worsted Corporation, Lawrence, Mass.

Ryan, Lawrence Francis, IV, '23 (B.T.C.). Chemist, Pacific Mills, Lawrence, Mass.

Ryan, Millard Kenneth Thomas, II, '24 (D). Textile Engineer, United States Testing Company, Inc., 316 Hudson Street, New York City.

Sanborn, Frank Morrison, VI, '19 (B.T.E.). With Standard Towel Company, Newton, N. J.

Sanborn, Ralph Lyford, VI, '16 (B.T.E.). With Manville Jenckes Company, Gastonia, N. C.

Sandlund, Carl Seth, VI, '25 (B.T.E.). With Mohawk Carpet Mills, Inc., (Shuttleworth Division), Amsterdam, N. Y.

Sargent, Robert Edward, IV, '25 (B.T.C.). With Bradford Dyeing Association, Bradford, R. I.

Sargent, Walter Ambrose, I, '22 (D). Instructor, Textile Shop Practice, Passaic, N. J.

Saunders, Harold Fairbairn, IV, '09 (D). Treasurer, Chemical Specialties Company, Cleveland, Ohio.

Savery, James Bryan, II, '23 (D). In Designing Department, Berkshire Woolen Company, Pittsfield, Mass.

Sawyer, Joseph Warren, IV, '15 (B.T.D.). Assistant Chemist, Franklin Mills, Franklin, N. H.

Schaetzel, André Paul, IV, '21 (B.T.C.). Chemist, Uhlig Piece Dye Works, Haledon, N. J.

Schwarz, Herman Louis, IV, '22 (B.T.C.). Salesman, Ciba Company, Inc., Providence, R. I.

Scott, Gordon Maxwell, IV, '20 (B.T.C.). Chemist, Holden-Leonard Company, Bennington, Vt.

Shaber, Hyman Jesse, VI, '17 (B.T.E.). With C. F. Hovey Company, Boston, Mass.

Shanahan, James Edward, II, '22 (D). With Stephen Sanford & Sons, Amsterdam, N. Y.

Shananquet, Mrs. Lee (Woodies, Ida A.), IIIb, '00 (C). 123 Earldon Avenue, S. E., Grand Rapids, Mich.

Shea, Francis James, II, '12 (D). Clerk, Corticelli Silk Company, Florence, Mass.

Shenker, Nahman, III, '25 (D). 1746 President Street, New York City.

Sidebottom, Leon William, IV, '11 (D). Colorist, Essex Aniline Works, Inc., South Middleton, Mass.

Sjostrom, Carl Gustof Verner, Jr., III, '17 (D). Assistant Superintendent, Farnsworth Mills, Inc., Central Village, Conn.

Sleeper, Robert Reid, IV, '00 (D). Textile Colorist, Calco Chemical Company, Bound Brook, N. J.

Smith, Albert Adams, I, '99 (D). Deceased.

Smith, Doane White, II, '10 (D). General Superintendent, Chelsea Fibre Mills, 1155 Manhatten Avenue, Brooklyn, N. Y.

Smith, Frank Kenfield, II, '24 (D). 32 School Street, Montpelier, Vt.

Smith, Herbert Jeffers, VI, '22 (B.T.E.). Overseer of Ring Spinning, Potter Fine Spinners, Inc., Pawtucket, R. I.

Smith, Ralston Fox, I, '04 (C). Sales Manager, W. H. Warner & Co., Union Commerce National Bank Building, Cleveland, Ohio.

Smith, Stephen Eaton, I, '00 (D). Professor of Textiles; in charge of Cotton Yarn Department, Lowell Textile School, Lowell, Mass.

Smith, Theophilus Gilman, Jr., IV, '10 (D). Farming, Groton, Mass.

Snelling, Fred Newman, II, '03 (D). With the American Railway Express Company, Haverhill, Mass.

Sokolsky, Henry, VI, '17 (B.T.E.). Head of Time Study Department, B. F. Sturtevant Company, Hyde Park, Mass.

Somers, Benjamin, II, '25 (D). 128 Pleasant Street, Brookline, Mass.

Southwick, Charles Hudson, IV, '22 (B.T.C.). Assistant Dyer, Woonsocket Dye Works, Woonsocket, R. I.

Spiegel, Edward, II, '03 (C). Theatrical Business, New York City.

Standish, John Carver, IV, '11 (D). Superintendent, Albany Felt Company, Albany, N. Y.

Steele, Everette Vernon, IV, '24 (B.T.C.). Salesman and Demonstrator, Rohm & Haas Co., 40 North Front Street, Philadelphia, Pa.

Stevens, Dexter, I, '04 (D). General Manager, Esmond Mills, Esmond, R. I.

Stevens, Raymond Russell, IV, '19 (B.T.C.). Overseer of Dyeing, The Felters Company, Inc., Millbury, Mass.

Stevenson, Murray Reid, III, '03 (C). Farming, Princeton Depot, Mass.

Stewart, Arthur Andrew, II, '00 (D). Professor of Textiles; in charge of Finishing Department, Lowell Textile School, Lowell, Mass.

Stewart, Walter Lawrence, III, '03 (D). In Real Estate Business, 257 West 100th Street, New York City.

Stiegler, Harold Winfred, IV, '18 (B.T.C.). (M.S. 1922, Ph.D. 1924, Northwestern University). Instructor in Chemistry, Lowell Textile School, Lowell, Mass.

Stohn, Alexander Charles, III, '06 (C). Factory Superintendent, C. Stohn, Hyde Park, Mass.
Stone, Ira Aaron, IV, '09 (D). Vice-President, Royal Manufacturing Company, 115 Federal Street, Boston, Mass.
Storer, Francis Everett, II, '07 (D). Cashier, Windham County National Bank, Danielson, Conn.
Stronach, Irving Nichols, IV, '10 (D). With Hampton Company, Easthampton, Mass.
Stursberg, Paul William, II, '07 (D). Died in 1913.
Sturtevant, Albert William, IV, '17 (D). Automobile Mechanic, Harry Pitts Motor Sales , 52 Hurd Street, Lowell, Mass.
Suhlke, Waldo Eric, IV, '20 (B.T.C.). 7 Banks Street, Waltham, Mass.
Sullivan, John David, VI, '12 (D). With Robert Gair Company, Bradford, Mass.
Sullivan, Lambert William, II, '23 (D). With Rockford Knitting and Hosiery Company, Rockford, Ill.
Sullivan, Willard David, II, '23 (D). Student, Lowell Textile School, Lowell, Mass.
Sunbury, Herbert Ellsworth, VI, '18 (B.T.E.). Assistant Superintendent, Multibestos Company, Walpole, Mass.
Sutcliffe, Henry Mundell, II, '25 (D). With Uxbridge Worsted Company, Uxbridge, Mass.
Sutton, Leslie Emans, I, '17 (D). Superintendent, Anniston Cordage Company, Anniston, Ala.
Swan, Guy Carleton, II, '06 (D). Chemist, in charge of Imports, United States Department of Agriculture, 641 Washington Street, New York City.
Sweeney, George Hamilton, II, '24 (D). Salesman, Walker Stetson Company, 157 Essex Street, Boston, Mass.
Sweet, Arthur Dutcher, VI, '21 (B.T.E.). Cupola Foreman, Wilson Foundry and Machine Company, Pontiac, Mich.
Swift, Edward Spooner, S. J., I, '02 (D). Clergyman, Church of the Immaculate Conception, Boston, Mass.
Sylvain, Charles Emile, VI, '13 (D). Resident Engineer, Saco-Lowell Shops, and Textile Engineer for International Machinery Company, Rua S. Pedro, 66, Rio de Janeiro, Brazil.
Syme, James Francis, II, '00 (D). Vice-President and General Manager, Southern Worsted Corporation, Greenville, S. C.
Symmes, Dean Whiting, IV, '22 (B.T.C.). Chemist, National Aniline and Chemical Company, 113 High Street, Boston, Mass.

Thaxter, Joseph Blake, Jr., II, '12 (D). With Smith & Dove Manufacturing Company, Andover, Mass.
Thomas, Roland Vincent, I, '05 (C).
Thompson, Arthur Robert, Jr., IV, '22 (B.T.C.). Southern Sales Representative, Rohm & Haas Company, Inc., 905 Independence Building, Charlotte, N. C.
Thompson, Everett Leander, I, '05 (D). Agent, Gulf Refining Company, Bradford, Mass.
Thompson, Henry James, IV, '00 (D). Dyer, United States Rubber Company, Malden, Mass.
Tilton, Elliott Thorp, II, '99 (D). Died January, 1917.
Todd, Walter Ernest, III, '23 (D). Superintendent, Lawrence Keegan Company, Wilsonville, Conn.
Toepler, Carl, IV, '22 (B.T.C.). Chemist, Pacific Mills, Lawrence, Mass.
Toovey, Sidney Ernest, II, '04 (C). Deceased.
Toshach, Reginald Alexander, II, '11 (D). Assistant Superintendent, M. T. Stevens & Sons Company (Pentucket Mills), Haverhill, Mass.
Toupin, Stephane Frederick, VI, '24 (B.T.E.).
True, William Clifford, II, '22 (D). Rate Clerk, Chelsea Fibre Mills, Brooklyn, N. Y.
Tyler, Lauriston Whitcombe, II, '16 (D). Salesman, W. T. Grant Company, 315–319 Summit Street, Toledo, Ohio.

Valentine, Burnet, VI, '23 (B.T.E.). Salesman, James C. Erskine Corporation, 15 Thomas Street, New York City.
Varnum, Arthur Clayton, II, '06 (D). Superintendent, Hamilton Woolen Company, Southbridge, Mass.
Villa, Luis Jorge, IV, '25 (B.T.C.). Medellin, Colombia, S. A.
Villa, William Horace, VI, '24 (B.T.E.). Textile Engineer, Compania Colombiana de Tejidos, Medellin, Colombia, S. A.

Walen, Ernest Dean, VI, '14 (B.T.E.). Assistant to the Agent, Pacific Mills, Lawrence, Mass.
Walker, Alfred Schuyler, II, '11 (D). 67 Park Avenue, Saranac Lake, N. Y.
Walker, Anna Gertrude, IIIb, '03 (C). See Pradel, Mrs. Alois J.
Walker, Raymond Scott, II, '23 (D). Department Superintendent, Chelsea Fibre Mills, 1155 Manhattan Avenue, Brooklyn, N. Y.
Wang, Chen, IV, '23 (B.T.C.). Student, Graduate School, Cornell University, Ithaca, N. Y.
Wang, Cho, VI, '23 (B.T.E.).
Wang, Tung Chuan, VI, '23 (B.T.E.).
Wang, Yung Chi, II, '21 (D).
Warren, Philip Hamilton, II, '05 (D). Superintendent, Hopeville Manufacturing Company, Worcester, Mass.
Washburn, John Milton, Jr., IV, '21 (B.T.C.). Salesman and Demonstrator, National Aniline and Chemical Company, Inc., 113 High Street, Boston, Mass.
Watson, William, III, '11 (D). Real Estate, Frank E. Watson, 25 Washington Squar , Haverhill, Mass.
Webb, Frank Herbert, IV, '04 (D). Died March 20, 1919.
Webber, Arthur Hammond, IV, '01 (D). Chemist and Demonstrator, Melville Color Company, 93 High Street, Boston, Mass.
Webster, Joseph Albert, VI, '23 (B.T.E.). Overseer, Ludlow Manufacturing Associates, Ludlow, Mass.
Weinstein, Edward Joseph, VI, '25 (B.T.E.). 197 Fremont Street, Harrison, N. J.
Weinz, William Elliot, IV, '08 (D). Salesman, General Dyestuff Corporation, 111 Arch Street, Philadelphia, Pa.
Wells, Ai Edwin, VI, '20 (B.T.E.). Instructor, Electrical Engineering, Lowell Textile School, Lowell, Mass.
Wheaton, Walter Francis, VI, '23 (B.T.E.). Sales Engineer, Hyatt Roller Bearing Company, 708 Park Building, Worcester, Mass.
Wheelock, Stanley Herbert, II, '05 (D). Secretary and Treasurer, Stanley Woolen Company, Uxbridge, Mass.
Whitcomb, Roscoe Myron, IV, '10 (D). Pharmacist, R. M. Whitcomb, Ashland, N. H.
White, Royal Phillip, II, '04 (D). Agent, Stirling Mills, Lowell, Mass.
Whitehill, Warren Hall, IV, '12 (D). Chemist, Brightwood Manufacturing Company, North Andover, Mass.
Wightman, William Henry, IV, '06 (D). Salesman, Ciba Company, Inc., 93 Broad Street, Boston, Mass.
Wilcox, Leonard Edward, VI, '24 (B.T.E.). Rate Setter, Saco-Lowell Shops, Lowell, Mass.
Williamson, Douglas Franklin, I, '22 (D). Assistant Superintendent, American Net and Twine Company, Blue Mountain. Ala.
Wilman, Rodney Bernhardt, II, '25 (D). Designer, Amoskeag Mills, Manchester, N. H.
Wilson, John Sigmund, II, '03 (D.). Deceased.
Wilson, Walter Ernest Hudson, I, '04 (C). Deceased.
Wing, Charles True, '02 (D). Paymaster, Merrimack Woolen Corporation, Dracut, Mass.
Wingate, William Henry, IV, '08 (D). Superintendent of Dyeing, Franklin **Process Company, Providence, R. I.**
Wise, Paul Tower, II, '01 (D). Vice-President, Chelsea Fibre Mills, 212 Fifth Avenue, New York City.

Woo, Tsunkwei, VI, '19 (B. T. E.). Manager of Trading Department, The Continental Corporation of China, Shanghai, China.

Wood, Ernest Hadley, S.B., IV, '11 (D).

Wood, Herbert Charles, I, '06 (D). Assistant Superintendent, Union Wadding Company, Pawtucket, R. I.

Wood, James Carleton, IV, '09 (D). Travelling Representative, R. T. Vanderbilt Company, New York City.

Wood, Lawrence Burnham, IV, '17 (B.T.C.). Chemist, Standard Bleachery, Carlton Hill, N. J.

Woodcock, Eugene Close, II, '07 (D). Agent, Chelsea Fibre Mills, 1155 Manhattan Avenue, Brooklyn, N. Y.

Woodies, Ida Alberta, IIIb, '00 (C). See Shananquet, Mrs. Lee.

Woodhead, Joseph Arthur, VI, '23 (B.T.E.). With United States Testing Company, 340 Hudson Street, New York City.

Woodman, Harry Lincoln, I, '02 (C). Draftsman, Merrimac Chemical Company, Woburn, Mass.

Woodruff, Charles Beauregard, I, '06 (C). Secretary and Buyer, Millsap, Woodruff, Cousins Company, Birmingham, Ala.

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NOTE. — There has been so much interest during the past few years and especially during the last year in the properties of rayon that it is felt that the following articles which have appeared in the American Dyestuff Reporter and which were written by members of teaching staff at this school will be timely and of value to the industry.

A GENERAL SURVEY OF THE DYEING OF ARTIFICIAL SILKS OR RAYONS

By LOUIS A. OLNEY, B.S., M.S., Sc.D., PROFESSOR OF CHEMISTRY AND DYEING

As some of the readers may not be directly concerned with the textile industry, and many may not be fully conversant with the character of the dyes available for the purpose of coloring textile materials, it may be advisable to classify, from the dyer's point of view, the various fibers used by textile manufacturers, and also indicate a few rather broad groups into which the dyes may be divided. In this way we may be able to create a background which will prove of considerable value in developing a clear conception of the problems involved in the dyeing of the various types of artificial silk or rayon.

The classification of fibers shown in Table I recognizes three rather distinct groupings:

(1) The Animal Fibers.
(2) The Vegetable Fibers, including the Regenerated Cellulose Rayons.
(3) The Cellulose Acetate Rayons.

Between all three there is a decided difference in the chemical composition of the fiber substance. The animal fibers are nitrogenous, containing as high as 18 to 20 per cent of nitrogen. This nitrogen occurs to some extent in the form of complicated amino acids, a fact which adds considerably to the chemical activity of the fiber substance, the amino or (NH_2) groups exerting a basic action under certain circumstances and the carboxyl (COOH) groups, an acid reaction under other conditions.

The vegetable fibers on the other hand are non-nitrogenous, and do not contain carboxyl groups in their structure, but are for the most part carbohydrates of the cellulose type in which the hydroxyl (OH) groups are the most active, and these do not appear to be particularly reactive toward dyes. The regenerated celluloses, as the term indicates, are practically pure cellulose and naturally act similar to cotton.

A	Wool Silk	Animal Fibers
B	Cotton Linen	Vegetable Fibers
	Viscose Cuprammonium Nitro	Regenerated Cellulose
C	Celanese Lustron	Cellulose Acetate Group

TABLE I

With the cellulose acetate group of rayons, however, we have an entirely different condition, for they do not contain any straight cellulose but instead a cellulose ester of acetic acid which, roughly speaking, contains almost as much acetic acid residue as cellulose residue. As a result these fibers have a reaction toward dyes entirely different from either of the first two groups.

In Table II an endeavor has been made to indicate in a compact manner the affinity or, perhaps better, the usability of the common classes of dyes in conjunction with the different fibers. At the left will be found the fibers in accordance

TABLE II

FIBER GROUP		Basic Dyes	Acid Dyes	Direct Cotton Colors	Sulphur Dyes	Vat Dyes	Mordant Colors	Special Dyes SRA, etc.
Group A	Wool	+ +	+ + +	+ +	—	+	+ + +	—
	Silk	+ + +	+ +	+ +	—	+	+ +	—
Group B	Cotton	—	—	+ + +	+ + +	+ + +	+	—
	Viscose	—	—	+ + +	+ + +	+ + +	+	—
	Cupram.	—	—	+ + +	+ + +	+ + +	+	—
	Nitro	+	—	+ +	+ +	+ +	+	—
Group C	Celanese	+ +	—	—	—	+	—	+ + +
	Lustron	+ + +	—	—	—	+	—	+ + +

with our classification of Table I and across the table the columns represent the different classes of dyes. Where a dye is applicable to the indicated fiber (+) signs are used, and where not usable (−) signs. The relative degree of usability is in some instances expressed by the number of (+) signs used.

In studying these tables it must be remembered that the general trend of the dyes as groups is recorded rather than absolute correctness as to each individual dye.

For instance, the action of acid dyes with acetate silk is put down as (−) although a very few acid dyes may be found that will dye this fiber. Again, the direct cotton colors with acetate silk are put down as (−). The actual facts of the case are that about 60 per cent of these dyes do not dye the fiber at all and the remainder for the most part only stain it or at the best dye it with difficulty. In the column marked Basic Dyes, their direct action is noted rather than their action in conjunction with a tannin mordant.

The important things to be observed upon this table are:

(1) That the fiber groups A, B and C act quite differently.

(2) That the regenerated celluloses for the most part act the same as vegetable fibers.

(3) That the acetate silks are in a class by themselves, acting quite differently from the animal and vegetable and regenerated cellulose fiber.

As a result of these differences it is possible to obtain two or even three color effects in the dyeing of fabrics which contain a combination of fibers of classes A, B and C.

Dyeing Properties of Regenerated Cellulose Type

The dyeing of rayons of the regenerated cellulose type, namely, the cellulose nitrate, cuprammonium and viscose silks, presented no unusual dyeing problems even during their early days. To be sure, certain difficulties have arisen in dyeing these fibers and material containing them, but these difficulties have been due to errors in mechanical manipulation rather than lack of methods of dyeing. Being in substance almost identical with cotton, these particular rayons may be dyed with the same dyes and in much the same manner. The dyeing properties of

cellulose nitrate silk are the least like cotton of the three, but the reason for this is plainly seen if we consider that when formed it is really a cellulose salt of nitric acid and if allowed to remain in this condition it would be closely allied as far as chemical classification is concerned to the acetate silk, which is in reality a cellulose ester or ethereal salt of acetic acid. The process of rendering the cellulose nitrate silk non-inflammable, commonly designated as denitrating, converts this saltlike compound largely, although perhaps not wholly, into a form quite similar to the cellulose from which it was originally made. The dyeing properties of cellulose are therefore for the most part restored but not to the same extent as in the case of the cuprammonium silk which when finally finished is practically pure cellulose. This difference in the dyeing properties of cellulose nitrate silk is exhibited chiefly in its greater affinity for basic dyes. In fact, it is possible to dye the nitro silk directly and quite satisfactorily with certain selected basic dyes. To apply basic dyes to the viscose and cuprammonium silks a tannin mordant is essential. Even with the nitro silk better and faster colors are produced in conjunction with a tannin mordant.

Direct cotton colors and sulphur dyes are applied to all three of these silks by methods similar to those of cotton dyeing. Lower temperatures are used, especially in the case of the nitro silk, and also a reduced percentage of Glauber or common salt. Alkali as well as sodium sulphide should be reduced to a minimum and caustic alkali entirely omitted if possible. The addition of sulphonated oils is also decidedly beneficial.

The vat dyes are also applied in a manner similar to that for cotton dyeing, that is, in an alkaline, hydrosulphite reduction vat.

As is the case with cotton the acid dyes have no real affinity for the regenerated celluloses under any conditions and the mordant dyes only when used in conjunction with certain metallic mordants.

Problems in Processing Acetate Silk

The cellulose acetate silks, however, presented problems in dyeing which did not exist as far as the regenerated cellulose silks were concerned; in fact, it was found that this material acted entirely different from any other fiber. Its obstinacy as you might call it, when it came to the absorption of dyes, led to the prediction on the part of some of the less visionary that it would never become extensively used as a textile fiber. About the only members of the regular list of dyes for which it showed any special attraction were the basic colors and these, of course, did not offer any thing very promising as far as fastness was concerned. Most of the direct cotton colors showed little if any affinity and the acid dyes even less. Many of the existing dyestuffs were tried and by going through the whole list in an exploratory manner one would be found now and then that was an exception to the rule or which by some unusual or freak method might work with some degree of satisfaction. The so-called "cellutyl colors" were a specially selected group of such miscellaneous dyes.

One of the early attempts to solve the problem of dyeing acetate silks was the application of the principle of saponification or deacetylation to the cellulose acetate. It was found that by treating the acetate silk with caustic alkalies, hydrolysis took place and the fiber substance became almost identical with that of the regenerated celluloses. The saponified fiber immediately developed a marked affinity for dyestuffs and could be dyed with direct cotton, sulphur, vat, and other dyes in a similar manner to cotton. This method, however, proved to be decidedly impracticable, since it impaired some of the most valuable properties of the fiber, and the removal of the acetyl group necessarily brought about a great loss in weight. Furthermore it was difficult to carry out this hydrolysis uniformly and as a result uneven dyeing usually followed.

In some instances it was found that the addition of certain metallic salts facilitated the absorption of dyes and a number of patents were taken out covering their use.

Another important discovery was that acetate silk readily absorbed many amino

bases as, for instance, aniline and some of its derivatives. Once on the fiber these amino bases could be diazotized and then developed with phenolic or naphtholic compounds, e.g., beta-hydroxy naphthoic acid, thus producing colored compounds or dyes within the fiber substance. As a result several series of suitable bases have been put upon the market under various trade names such as azonils, acedronoles and azonines. The silkons are also of this type.

Almost innumerable patents have been taken out for the dyeing of acetate silk, and Chas. E. Mullin in his exceptionally complete series of articles upon the dyeing of acetate silk which is being published in the AMERICAN DYESTUFF REPORTER at the present time, gives with some detail no less than 135 methods for dyeing acetate silk, which have been described in the literature.

Notwithstanding this array of patents and processes it was not until those most vitally interested came to the realization that the problem of dyeing cellulose acetate could be satisfactorily solved only by devising special dyes or by producing some of the older dyes in a considerably modified form that real progress was made.

SPECIAL DYES FOR ACETATE SILKS

One of the earliest and most successful attempts to produce a new type of dye suited for this purpose was the introduction of the Ionamines by Green and Saunders (J. S. D. C., Jan., 1923, page 10). The solubility of the Ionamines is due to an external or omega sulphonic acid group which splits off gradually during the dyeing process, liberating the insoluble dye base which is readily absorbed by the fiber. The dye base thus formed may in many cases be diazotized and developed with phenolic or naphtholic derivatives, giving a wide range of colors of very good fastness. The introduction of the Ionamines was a step in the right direction, but their application involved complications which did not wholly appeal to the practical dyer.

The most important advancement as regards the dyeing of acetate silk was the introduction, about two years ago, of the so-called SRA colors. These solved to a great extent the problem of easily producing, by direct dyeing, a wide range of colors of excellent fastness in most respects. They were the result very largely of the study and investigation of Dr. G. Holland Ellis, and were produced under his supervision at the works of the British Celanese Company. The characteristic properties of these dyes are described by Ellis in an article, entitled "Dyeing by Colloidal Solubilization or Dispersion of Insoluble Coloring Matters." (J. S. D. C., Sept., 1924; reprinted in the Am. D. R. Nov. 3, 1924).

According to Ellis the SRA methods of dyeing are the results of the conception of a means not of chemical but of "physical solubilization," or better "colloidal dispersion" of the ordinary insoluble coloring matters in order to render them properly available to the fiber. This was successfully accomplished by the use of sulphoricinoleic-acid (sulphonated castor oil), hence the characterizing name of SRA. It was found that when a ricinoleic-acid solution of a number of dyes and organic compounds ordinarily insoluble in water, was poured into water a dispersion of the particles took place which was so fine and so complete as to retain the characteristics of a water solution to such an extent as to pass freely through ordinary filter paper. Such colloidal dispersions may be neutralized and even made alkaline without apparently changing their character and from them acetate silk readily and uniformly absorbs the dye particles. Through exhaustive study and experimentation, also largely by the process of elimination, a series of dyes of remarkable fastness, brilliancy and range of coloring possibilities has been devised. They are all placed upon the market under the brand name of SRA colors[1] in the form of 10 per cent pastes, in which are incorporated both the dye and the dispersing medium, in such a form that they may be used as readily as any soluble dye.

The process of application is extremely simple. The necessary amount of dye paste is added to a soap bath and heated to 75 to 80 deg. Cent., and the material

[1] The manufacturers of SRA dyes hold exclusive rights that permit their use only in conjunction with Celanese.

worked in this until the dyestuff has been properly absorbed. The addition of Turkey Red oil facilitates the absorption of dye, and when dyeing heavy shades a moderate quantity of salt may be added to advantage. Many of the SRA colors may be dyed cold and the individual dyes may be mixed to almost any extent in the production of compound shades.

In addition to the direct dyeing colors of this group there are the SRA diazo solamines, a series of amino bases or at least amino bodies capable of being diazotized. They are subject to colloidal dispersion through the same medium, sulpho-ricinoleic acid, and having been absorbed by the fiber from such a dispersion bath they are subsequently diazotized and developed.

The Duranol dyes of the British Dyes, Ltd., and the Celatine of the Scottish Dyes, Ltd., which are said to be sulphonated anthraquinone derivatives act similarly to the SRA colors. The Duranol dyes, however, are incorporated with a special dispersion medium quite different from the SRA colors but are applied by similar methods.

In the so-called sulphato dyes we have a group of modified acid dyes suitable for dyeing acetate silks. These are based upon the discovery that the presence of the ethereal sulphuric acid group — $C_2H.\ SO_4$ — H attached to nitrogen has a somewhat similar function to the sulphonic acid group. Certain dyes containing such groups are readily taken up by acetate silk from neutral acid, or alkaline baths producing a variety of shades of good fastness to light and washing.

Quite recently a group of Setacyl Direct dyes for acetate silk has been announced by the Geigy Company. They are in a powder form, directly soluble in boiling water, and may be applied to acetate silk in a neutral salt bath the same as direct cotton colors.

These developments in regard to the dyeing of acetate silk have for the most part taken place within the past three years. Through them there has been opened an entirely new trend of thought in regard to the application of dyes and with this an impetus to the further study of various phases of the theory of dyeing. Some even prophesy that the new knowledge gained through the quest of suitable dyes for acetate silk may eventually lead to radical modifications of our present methods of dyeing other fibers.

Cross Dyeing and Multi-Color Effects

A study of Table II will reveal several very pronounced differences between the dyeing properties of Fiber Groups A, B and C. By taking advantage of these differences it is easily possible to produce two-color effects in a single dye bath, and by using some discretion in the selection of dyes, and a little ingenuity in manipulation, even three-color effects may be produced upon undyed material if made with the proper mixture of fibers. In this way the lack of affinity of acetate silks for dyes is used to great advantage in the production of many attractive combination color effects, and what was originally thought to be a serious defect in their make up has really proven to be one of their most useful properties.

The simplest contrast effects may be produced upon mixtures of Group B and Group C fibers. For instance, if cotton or viscose rayon are combined with acetate silk the former may be dyed with a direct cotton color without even staining the acetate silk. By using a special acetate silk dye, e.g., one of the SRA colors, it is possible to reverse the process and leave the cotton or viscose unstained. The two processes may then be combined either by using separate baths or in a single bath, thus producing two-color effects of almost any degree of contrast.

In real silk and acetate silk combinations the real silk may be dyed with acid dyes and the acetate silk with SRA or similar dyes. Some of these dyes may also stain the silk to a slight extent, but this need not necessarily interfere with the production of excellent two-color effects.

In a real silk and Group B fiber mixture the real silk may be dyed with an acid dye, and the other fiber dyed with a direct cotton color. It is possible, by careful selection, to obtain direct cotton dyes that will scarcely stain the real silk, in which case the characteristic color of the acid dye will be maintained upon the silk. In

case the direct cotton dye is one that dyes silk fiber the color on the silk will be a combination of the two dyes. Thus if an acid yellow and a direct cotton blue were used the Group B fiber would be dyed blue and the real silk green.

It might be well to note that direct cotton dyes will often rather unexpectedly stain acetate silk. This may not be a fundamental defect of the particular direct cotton color, but due to the presence of a small quantity of some extraneous dye that has been added for shading purposes or to increase its brilliancy. To avoid such difficulties the manufacturers of the SRA dyes have put upon the market a brand of CR (Celanese Resist) colors which have been specially selected so as to avoid this difficulty.

Two-color effects may also be produced upon a Group B–Group C mixture by dyeing the Group C fibers with a basic dye and Group B fiber with a direct cotton color. In this case the proper choice of dyes and manipulation of temperature are of considerable importance. Basic dyes have a decided tendency to stain both fibers at low temperatures, but as the temperature rises the dye gradually leaves the Group B fiber and goes on to the acetate silk.

Three-Color Effects

In the production of three-color effects a mixture of all three fiber groups is commonly used. Thus a basic dye can be applied to the acetate silk Group C in a slightly acid bath, a direct cotton color to the Group B fiber, e.g., viscose or cotton, and an acid dye to the Group A fiber, e.g., silk, or wool. There would be a certain amount of overlapping, particularly between the acid dye and the direct cotton color, but nevertheless three distinct colorations may be produced. Other combinations may also be used in producing satisfactory multi-color effects.

Celanese and Lustron are fundamentally similar, but owing to the fact that they are manufactured by different concerns and by different processes they differ somewhat in their properties. Lustron will withstand higher temperatures and more alkali without affecting luster and strength than Celanese. Cotton piece goods with Lustron decorations may even be mercerized with caustic soda if the concentration is somewhat modified and the temperature kept at 40 deg. Fahr. or below. Lustron also has a greater affinity for basic dyes than Celanese. For these reasons Lustron has proved to be of considerable value in the production of multi-color effects and for decorative effect threads used in connection with woollen and worsted piece goods.

With both types of acetate silk it is well to keep the temperature as low as possible and reduce the alkalinity to a minimum. In general acid may be used more freely than alkali with the acetate silks, but the acid must be finally washed out at the end. Material containing Lustron should always be given an after-treatment with dilute sodium bicarbonate solution to insure that no acid remains. When acid must be used acetic acid is always preferable to mineral acids. Sulphuric acid should never be used with Lustron or a boiling temperature with Celanese.

Troubles Mechanical and Chemical

The dyer of artificial silk and of material containing this fiber often has worries and complications of a more serious nature than those coming from the actual application of the dyes.

In the first place various oils and softeners are frequently added to artificial silk to facilitate reeling, winding and processing in general. If these are of poor quality or of the wrong character they may cling to the fiber with great tenacity, and much difficulty may be experienced in removing them previous to dyeing.

When handling skeins the dyer has a constant struggle against tangling and every precaution must be taken in this direction or it may be impossible to satisfactorily reel the skeins after he is through with them.

Skein dyeing of artificial silk still has to be done by hand since no machine seems to have been devised for satisfactorily handling it in this form.

One of the most exasperating troubles is that of light and dark skeins. Certain skeins in the same lot of silk without any apparent reason will dye considerably darker or lighter than the others. Different lots from the same manufacturer will sometimes dye differently, and if these happen to be mixed in a woven fabric, unevenness of color is quite sure to result.

Serious troubles also frequently arise through the fact that many types of rayon lose much of their tensile strength when wet. The regenerated cellulose silks are undoubtedly the worst offenders in this respect since they often lose from 70 to 80 per cent of their original strength when wet out. Fortunately the original strength is restored upon drying, but before this takes place the fabric may have become hopelessly stretched out of shape.

The acetate silks are far superior in this respect. In their normal dry condition they are not as strong as the regenerated cellulose silks, but they lose so little when wet that their tensile strength under these conditions is superior.

In finishing a mixed fiber fabric unequal stretching of the rayon and lack of elasticity often causes troubles. All processes must be conducted in such a way as to avoid undue handling or stretching of the material when wet, and it should not be put through anything in the nature of a wringing machine.

In the home dyeing and dry cleansing of fabrics containing rayon, it is well to be sure which of the two types of fiber are present since they require different treatments. The so-called "home dyes," so many of which are on the market, will dye the regenerated cellulose silk quite well, if the material is carefully handled when wet, but most of them being of the direct cotton type will have little if any coloring action on the acetate silks.

Certain dry cleansing agents, particularly those of the halogenated type, also have a decided solvent action upon acetate silk, and may completely ruin a fabric if it contains much of this fiber.

The question is sometimes asked, "Why is it not possible to incorporate coloring matters with the spinning solution and produce a colored instead of colorless fiber and thus obviate the trouble and expense of dyeing. It would be possible to do this, in fact, it was done with some success during the early days of nitro silk. It is, however, impracticable for several reasons among which two are perhaps more outstanding than the others.

First, with practically all of the artificial silks the spinning solution is extremely sensitive to almost any extraneous influence. It must be prepared in a certan state of physical and chemical equilibrium in order to spin properly, and it is sufficiently difficult to properly maintain this condition even when practically the same spinning solution is used each time. The introduction of dyes of varying composition, and other necessary assisting chemicals would make it necessary to work out special spinning conditions for each dye or combination of dyes and undoubtedly complicate matters far in excess of any advantage that might be gained.

In the second place, the production of colored silk yarns by this method could not adjust itself to present day merchandising conditions. With styles and color requirements changing overnight, as it were, the manufacturer would continually find himself overstocked with colored silk for which there was no demand. Furthermore, the tremendous stocks of dyed silk which would have to be carried would be prohibitive.

Dyeing methods and the quality of dyed silk have also improved so much in the past few years that the desire for this direct method of coloring scarcely exists to-day.

In closing there are certain points to which I would specially call your attention.

First, that the rayons are not substitute fibers, but additional fibers. They do not replace either silk or cotton, but supplement them in many ways. When used with cotton, for instance, they make it possible to produce a fabric much more attractive in many ways at an extremely moderate increase in cost.

Second, that in many respects the rayons are quite different from other fibers, and therefore must be treated differently during the various dyeing and finishing

processes. The disregard of this fact perhaps more than anything else has been responsible for the unsatisfactory results that have sometimes been obtained in the dyehouse and finishing room.

Third, that there are two very different types of artificial silk: those of the regenerated cellulose type and those of the cellulose acetate type. They are as different as are cotton and wool, and must be dyed by different methods and handled quite differently in many respects.

Finally, the rayons or artificial silks have undoubtedly come to stay and must be allotted their place among the commercial fibers. The textile industry must adjust itself to their entry and the consuming public must learn what these fibers will do and what they will not do and thus adapt itself to their possible uses.

THE IDENTIFICATION OF THE VARIOUS TYPES OF ARTIFICIAL SILK OR RAYON

By A. K. Johnson, S.B., Instructor in Chemistry

The rapidly growing importance of artificial silks with respect to both consumption and extension of applications, the increase in commercial appearances of the different types on the American market, and the known differences in dyeing properties between the types makes it very desirable to have an easy and clearly distinguishing method for the identification of the "chemical" varieties.

While numerous methods of testing such types are to be found in the literature, experience with many of these methods would seem to indicate that they are not sufficiently distinctive in their showings as carried out by the casual or infrequent experimenter, to allow of interpretation. This may perhaps be due:

(1) To the need for adherence to close conditions in the preparation of the testing solutions or in the making of the tests, which conditions are not given in sufficient detail for universal reproduction.

(2) To the fact that with some types of artificial silk the differences in the appearances of the tested samples may be so slight as to require considerable experience before the differences can be interpreted, even with standards for comparison.

Simplicity of the Tests

The scheme for identification of the types of artificial silks, compiled below, would seem to possess considerable advantage to dealers or handlers of such silks in that the chemicals used are familiar to them, they present no difficulties in preparation, in storing or in use, and the results furnished appear easy to interpret without special experience. In the case of distinguishing Cuprammonium from Viscose silk it is necessary to adhere closely to similar and specified conditions, and is best to compare the behavior of the unknown sample with that of a standard sample in the same physical condition (tightness or looseness of the filaments in a yarn or waste).

Types of Artificial Silks Dealt With

The "chemical" types of artificial referred to in this scheme are:

(1) Cellulose derivatives, or esters, so-called acetate silks: (*a*) Lustron, (*b*) Celanese.

(2) Regenerated or hydrated cellulose: (*c*) Nitro silks, Tubize, etc., (*d*) Cuprammonium silk, (*e*) Viscose silk.

Chemicals or Solutions Used

The following chemicals or solutions are employed:

1. Glacial or strong acetic acid, water white.

2. Diphenylamine in concentrated sulphuric acid c.p. or commercial grade. One gram of the diphenylamine is dissolved in 100 grams of cold acid. It may be added to the silk by means of a medicine dropper or a dropping bottle with convenience.

3. Dyestuffs possessing differences in dyeing affinities for the various types, and kept in stock solutions (as 1 gram in 1,000 c.c. of water). Such dyes may be

(*a*) Methylene Blue, used for distinguishing Lustron from Celanese.

(*b*) Pontamine Scarlet B, or its equivalent, and

(*c*) Sulphur Khaki Y, or its equivalent, both used separately for staining Cuprammonium silk heavier than Viscose.

4. Millon's reagent, made by dissolving metallic mercury in its own weight of concentrated, c.p. nitric acid, then diluting the solution with an equal volume of water. Sometimes a new lot of this reagent does not work (perhaps due to the nitric acid used), and so each lot should be tested by moistening scoured wool or

real silk with it, gently warming and noting the production of a brick red color on the animal fiber. This reagent, if found reactive should be kept in a small, tightly stoppered bottle, when it will usually retain its staining power for a long time. It is used as a stain for animal fibers — here for real silk.

Preparation of the Samples

For use in the differential staining tests it is desirable to have the artificial silk fibers of a light or white color, and free from foreign substances like oil, dressing or bleaching materials. The use of weighed samples ($\frac{1}{4}$ to $\frac{1}{2}$ gram if available) is recommended for the Cuprammonium Viscose tests.

In comparing the stained samples it helps to have the yarns or fibers in a similar condition of looseness or tightness of twist of compression.

Real vs. Artificial Silk

Millon's Reagent, Brick Red with Real Silk (*Test No. 1*). — The mixed or separate kinds of fibers are covered with a few drops of Millon's reagent, and gently warmed (not boiled) when a brick red color will develop in the presence of real silk in a few seconds. Artificial silk remains white or unchanged.

If it is desired to preserve the stained sample it may be washed with dilute nitric acid until all the mercury salts are gone and then with water until free from acid.

Acetate Silks

Silks Soluble in Glacial Acetic Acid (*Test No. 2*). — Acetate silks only have a ready or appreciable solubility in glacial acetic acid or hot acetic acid of greater strength than 65 per cent. If the acid solution is diluted with water the dissolved silk will precipitate out either as a milky unstable "emulsion" or as a translucent glutinous material, depending upon the amount and kind of silk in the solution. This property may be made use of in testing mixed silks, as in waste artificial silks.

A tiny thread suffices for the test if more is not to be had. If the thread dissolves in the cold or hot strong acetic acid, it is an acetate silk.

If the thread does not dissolve and circumstances demand its use for other tests it may be washed free of acid and used in the diphenylamine test for Nitro silk.

Acetate Silks: Lustron vs. Celanese

Deep Blue with Methylene Blue, Lustron (*Test No. 3*). — Immerse a thread of the oil-free silk in 10 to 15 c.c. of the stock Methylene Blue (1 to 1,000), acidify with 1 to 2 c.c. actic acid and bring rapidly to a boil while agitating the silk in the heating liquor. As soon as the liquid is boiling pour off and wash the sample thoroughly in clean water.

Lustron retains a deep blue color.

Celanese reduces to a faint blue, relative to the Lustron Blue, in a very few seconds of washing.

Soluble in Boiling 45 to 50 Per Cent Acetic Acid; Precipitated as an Opaque Bulky Mass on Addition of Water — Celanese — (*Test No. 3a*). — There appears to be an appreciable difference in the strength of acetic acid necessary to readily and completely dissolve the two silks, Lustron and Celanese. Roughly determined in a qualitative way (using 0.05 grams of thread and 30 c.c. portions of acid of varying strengths) it has been found that Celanese silk will dissolve in acid of 45 to 50 per cent strength near the boiling temperature, whereas to dissolve Lustron under similar conditions requires an acid of 60 to 65 per cent.

Furthermore, there is a notable difference in the behavior of the solutions obtained above on dilution with water. The 30 c.c. of acid containing the Celanese silk in solution, when poured into 15 c.c. of water, gave a bulky, opaque mass which soon settled to a white flocculent sediment. The Lustron solution, on similar treatment, produced barely any opaqueness and some evidence of a translucent sediment.

Hence, if a thread of the silk dissolves in boiling 50 per cent acetic acid, and gives this characteristic turbidity upon this dilution it may be taken as strong evidence as being Celanese silk.

Acetate vs. Regenerated Celluloses

Melting in the Burning Test — Acetate Silk — (Test No. 4). — The burning test serves very clearly to distinguish the acetate silks (Lustron or Celanese) from the regenerated cellulose silks (Nitro, Cuprammonium, Viscose).

The fibers to be tested may be twisted into a tight wad and then cautiously approached to a match flame, without being brought into actual contact with the flame. Under the influence of the heat acetate silks are seen to "melt" or "fuse" back forming a black knob or globule on the end which precedes the small, sputtering, relatively slow burning flame down the thread. If the flame be extinguished and the knob cooled this will be found to be somewhat hard and resistant to crushing.

The regenerated cellulose silks do not melt back but burn quietly and readily like bleached cotton fiber. The odor from the fumes is the same as that coming from burned cotton.

This test serves to distinguish the two general classes and can be made upon a very small amount of material.

Nitro vs Cuprammonium or Viscose Silk

Deep Blue with Diphenylamine — Nitro Silk — (Test No. 5.) — Treatment of the water-moistened thread with a 1 per cent solution of diphenylamine in concentrated sulphuric acid causes the fibers of Nitro Silk to assume an immediate deep blue color. The blue fibers are completely dissolved in a few seconds after yielding a blue colored solution.

This test appears to be specific for Nitro silk, since the fibers of other types of artificial silks are not colored blue.

Cuprammonium vs. Viscose Silk

Selective Staining with Appropriate Dyestuffs (Test No. 6.) — When Acetate and Nitro silks have been proved absent, a carefully but easily regulated differential staining test with dyestuffs which have a greater affinity for one of the types may be used. In carrying out the test it is highly desirable to have all staining conditions identical, using the unknown fiber in conjunction with both known samples for comparison after staining.

Any dyestuff which possesses a sufficient difference in affinity may be employed. Two which the author has found to give satisfactory results are: Pontamine Scarlet B or its equivalent, and Sulphur Khaki Y, both of which under the conditions of staining have a sufficiently greater staining power for Cuprammonium to make identification easy when compared to standards in the same physical condition and stained under exactly similar circumstances.

The following tried suggestions with Pontamine Scarlet B serve to standardize the staining procedure and to eliminate sufficiently all factors except the difference in affinity:

1. Equal weights of sample and standards, as $\frac{1}{4}$ or $\frac{1}{2}$ gram.
2. One per cent of color based on weight of air dried fiber.
3. Equal volumes of bath, as, for $\frac{1}{2}$ gram, made up to 200 c.c. with water.
4. Immersion of samples into the liquor at the same time and the same temperature (as in a common heating bath), heating to about 150 deg. Fahr. for ten minutes. The samples may then be washed thoroughly and compared wet or dry. Viscose is the lighter stained sample.

With Sulphur Khaki Y, which may be applied for a check test, the total dyestuff needed for a 3 per cent dyeing on all the samples may be dissolved in a common bath with the addition of 2 to 4 times the weight of dyestuff of fused sodium sulphide, the stock solution diluted to give 200 c.c of dye bath for each sample (of $\frac{1}{2}$ gram), then allocated for each and stained under conditions as for Pontamine Scarlet B. Cuprammonium is stained the heavier.

A strong dyeing solution as in ordinary cotton dyeing does not appear to be as satisfactory as this dilute staining bath, as with the heavier per cent of dyes and with salt the two types of silk may tend to even up in depth of shade.

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LOWELL, MASS.

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CALENDAR.

1926.

September 30, Thursday	Registration.
October 7, Thursday	Registration.
October 11, Monday	Opening of evening school.
November 25, Thursday November 26, Friday	Thanksgiving recess. No classes.
December 21, Tuesday	End of first term.

1927.

January 3, Monday	Opening of second term.
March 11, Friday	Closing of evening school.
April 7, Thursday	Graduation.

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Gerald Marston Brown . . . . . . 40 Lawrence Street, Lawrence.
Evening Instructor in Mathematics.

Gladys Pillsbury Dutton . . . . Tewksbury.
Evening Instructor in Freehand Drawing.

Jean Cameron . . . . R.F.D. No. 1, Lowell.
Evening Instructor in Freehand Drawing.

THE LOWELL TEXTILE SCHOOL.
EVENING CLASSES.
GENERAL INFORMATION.

Entrance Requirements.

All applicants to the evening classes must understand the English language and simple arithmetic. Those who are graduates of a grammar or high school are admitted upon certificate. Those who cannot present such a certificate are required to take examination in the subjects of English and arithmetic. In the examination in English a short composition must be written on a given theme, and a certain amount must be written from dictation. In the examination in arithmetic the applicant must show suitable proficiency in addition, subtraction, multiplication, division, common and decimal fractions, percentage, ratio and proportion. Opportunity to register or to take these examinations is offered each year, generally on the Thursday evenings of the two weeks previous to the opening of the evening school.

Registration.

Before entering the class a student must fill out an attendance card, which can be obtained at the office or from the instructors in the various departments.

Any student who has filed an attendance card and who wishes to change his course must notify the office before making the change.

Sessions.

The evening classes commence the second Monday of October and continue for twenty-one weeks. The school is open on four evenings each week during the period mentioned, except when the school is closed for holiday recesses.

Supplies.

Students must provide their own books, stationery, tools, etc., and pay for any breakage or damage that they cause.

Student's supplies will be sold from the co-operative store every evening school night from 6.45 to 8.15 P.M.

Fees and Deposits.

All evening courses are free to residents of Lowell. To those outside of Lowell the fee is $10 per year for *each course of two nights per week.* Students taking two courses or attending courses requiring more than two nights per week are required to pay $15 per year for three nights and $20 for four nights.

All fees and deposits must be paid in advance.

All students, whether from Lowell or not, taking Course (*a*), Chemistry and Dyeing Department, are required to make a deposit at the commencement of the course, — $5 for first-year students, and $10 for second-year students. A deposit of $10 will be required of all students taking Course (*b*), (*c*) or (*d*). This is to cover the cost of laboratory breakages, chemicals, apparatus, etc., and at the end of the year any unexpended balance is returned, or an extra charge made for the excess breakage.

Every student who takes the chemistry and dyeing course must check up his desk with the instructor of that department when he leaves the school. Any student not doing so will be charged 50 cents.

All students taking Machine-shop Practice will be required to make a deposit of $5. Any unexpended balance remaining at the end of the year will be returned to the student.

Report of Standing.

A report of standing covering the year's work is sent to all students who attend the entire year and take the necessary examinations.

Certificates.

The courses of the evening school are varied and arranged to meet the special needs of those engaged in the industry. They vary in length from one to four years, and at the completion of each course the certificate of the school is awarded, provided, however, that the student has been in attendance in the course during the year for which the certificate is granted.

GENERAL EVENING COURSES.

The Lowell Textile School now offers to students several general courses. For each course a definite schedule is arranged which requires attendance of from six to eight hours per week.

The object of these courses is to give young men of ambition an opportunity to obtain instruction in all the branches of science that are allied with their daily work. For example, one who is employed as a weaver in a textile mill may, by means of the courses in manufacturing, obtain knowledge of the manufacture of yarn, the production of a design, and the methods of finishing a fabric, as well as the manner of its weaving or knitting. In like manner the dyer may augment his knowledge of the chemicals and materials he is daily handling. The engineer and machinist may acquire a knowledge of the mathematics, science of mechanics, electricity and drawing that underlie all the work of an engineer.

It is recognized that the interests of such students lie in a particular field of industry, and these courses are designed to bear directly upon the special line, and supplement, as far as possible, the practical work in which the student is engaged during the day.

The student selects his course upon entrance, and continues a regular schedule of subjects for three, four or five years, as may be necessary for its completion.

In a word, any man having a common school education and the ambition to advance in his line may now secure a broad and comprehensive training in the subjects which will be of vital importance to him in obtaining the goal of his ideal.

These general courses are supplemented by partial courses in all the subjects given, so that a student who finds it impracticable to carry on all the subjects in a complete course may select and take such subjects as will be of most value to him in his work.

A student taking one of these courses may attend school during the periods in which the subjects which he selects are being given.

A description of all courses follows.

COTTON DEPARTMENT.

I. Cotton Manufacturing — 4 Years.

The Cotton Manufacturing course is designed to give a student a broad knowledge of the manufacture of cotton cloth. To do this he is required to spend three years in the department of cotton yarns, studying cotton and its conversion into yarn. A student taking this course also spends two years in weaving, one on plain and one on dobby weaving. Three years are spent in a study of the art of designing a fabric and the analysis of fabric already constructed. One year is spent in a study of the processes involved in finishing cotton fabrics. For detailed description, see subjects under Yarns, Weaving, Designing and Finishing.

Ia. Cotton Yarns — 3 Years.

The first year's work in cotton yarn manufacture consists of a study of cotton and its preparation for market, followed by a study of picking, carding and combing.

The work in the picking, carding and combing classes consists of lectures on these operations combined with problems that are peculiar to each operation such as the drafts used and the production of each process as well as the amounts of waste made. Special consideration is given to the adjustment and care of these machines and some laboratory demonstration is used to show the manner of adjusting machines for the purpose of controlling the weight of the product, the amount of work done in a day and the control of waste.

The second year's work includes a study of the drawing and roving processes and the calculations that accompany these operations. It consists also of lectures on the machines and demonstration of their adjustment, showing roll setting, draft and twist control, builder adjustment, spacing coils on the bobbin, and tension control.

During the third year the time is devoted to a study of ring and mule spinning and twisting, and as in previous years, the work consists of lectures and demonstration on the machines. During this year there is also some work done on the combing machine, particularly in the nature of its adjustment. In addition to these subjects, there is some work done in the way of planning the organization

of a cotton mill with a view to showing drafts, speeds, productions and number of machines of each kind necessary for the production of a given amount of a certain yarn.

II. Wool Manufacturing — 4 Years.

In the branch of yarn manufacture the student must elect either worsted yarns or woolen yarns. In other respects the course is the same.

During the first year, courses are given in wool fibers and the preliminary processes of their conversion into yarns, calculations of the mechanism of the machines and elementary instruction in cloth designing and analysis.

During the second year, students selecting the woolen yarn option follow a course in carding and mule spinning and continue the first-year work in design and cloth analysis. Those selecting the worsted yarn option do likewise, excepting that their course in yarn instruction is on the worsted systems.

In the third year, students of the woolen yarn option finish their instruction in yarn manufacture and add to the course of design and cloth analysis a course in weaving. Students of the worsted yarn option add the same course in weaving and continue the second-year courses of worsted yarn and designing and cloth analysis.

The fourth-year courses consist of weaving and finishing.

This course is arranged to give those engaged in the manufacture of woolens and worsteds instruction in the various branches of the work. It embraces a study of wools and allied fibers and the manner of manipulating from fibers to finished fabric, including all the processes of yarn manufacturing, weaving, designing and finishing.

For detailed description of subjects see page 10.

IIa. Woolen Yarns — 2 Years.

This course is offered for students who wish instruction in woolen yarn manufacture and consists of a lecture course during the first year on the various kinds of wool fibers, trade terms, sorting, scouring, carbonizing, etc., also of a course on carding. The second year continues the instruction on carding and then takes up a course on the mule and woolen yarn spinning.

IIb. Worsted Yarns — 2 Years.

For those who desire instruction in the manufacture of worsted yarns this course is offered. The first-year work consists of a lecture course on the various kinds of wool fibers, trade terms, sorting, scouring, carbonizing, etc., also a course in carding and the calculations involved in the mechanism of the machines, and a course covering gilling and combing and the processes of top making. The second year is devoted to detail study of the English and French systems of worsted yarn manufacture.

For detailed description of subjects see page 10.

DESIGN DEPARTMENT.

IIIa. Cotton Design — 3 Years.

For those who wish to devote intensive study to the designing of cotton fabrics this course of designing and cloth analysis is offered. Instruction is given in the design and analysis of the standard fabrics and as many of the fancy designs and weaves as the time will permit.

IIIb. Woolen and Worsted Design — 3 Years.

This course covers the design and analysis of standard woolen and worsted fabrics and is intended for those who wish to specialize in this branch of textile fabric manufacture. Special and fancy fabrics are studied to the extent that time will permit.

For detailed description of subjects see page 10.

Va. Cotton Weaving — 1 Year.

Vb. Woolen and Worsted Weaving — 2 Years.

Vc. Dobby and Jacquard Weaving — 1 Year.

These are called weaving courses, but in reality they might more properly be called courses in loom fixing, for particular attention is given to the mechanism of

the looms, the timing of the various parts, and the adjustments possible to produce desired results. Here, again, is an opportunity for students to fix, dismantle, erect and adjust looms in a way that could not be tolerated in any mill. Frequently students come to the classes with the knowledge that certain adjustments must be made upon a loom if certain results are to be obtained, but the reason for these is not known. The school offers the machine, time and instructor in order that the weaver or loomfixer may determine for himself the reason for some rule which he practices in his daily work. Not only can he become more familiar with the loom upon which he works every day, but he can study the operations of many other makes of looms.

For detailed description of subjects see page 10.

IIIc. Freehand Drawing — 3 Years.

In the course in freehand drawing, instruction is given in the drawing from models, casts and designs. Work is taken up in charcoal and also in colors. This course has appealed to many young women of the city, and it is believed that this is a most fortunate opportunity for both young women and young men of Lowell to acquire the elements of artistic designing.

CHEMISTRY AND DYEING DEPARTMENT.

Hardly any branch of applied science plays so important a part in our industrial world as chemistry. Many large mills employ the chemist as well as the dyer, and with the great progress which is being made in the manufacture and application of dyestuffs, a basic knowledge of chemistry becomes an absolute necessity to the dyer. Within a comparatively short distance from Lowell are establishments employing men who require some knowledge of chemistry but who may not necessarily use dyes. Some find a knowledge of analytical chemistry helpful in their everyday work.

To meet these varying needs of our industrial community, the school offers a two-year course in general chemistry, organic and inorganic, which may be followed by any one of three courses, viz., textile chemistry and dyeing, analytical chemistry, and textile and analytical chemistry. In order to take Courses IVb, IVc or IVd, candidates must have a certificate from Course IVa, or show by examination or approved credentials that they have taken the equivalent of the work covered by this course.

For detailed description of subjects see page 10.

IVa. Elementary Chemistry — 2 Years.

General Chemistry, including Inorganic and Organic.

Qualitative Analysis.

One lecture and one Laboratory Period per week in General Chemistry the first year, continued three nights a week during the second year, when the Elementary Organic Chemistry and Qualitative Analysis is completed.

IVb. Textile Chemistry and Dyeing — 3 Years.

Lectures in Textile Chemistry and Dyeing.

Laboratory Work in Dyeing.

Covered by 40 lectures and two nights of laboratory work per week.

IVc. Analytical Chemistry — 3 Years.

Laboratory Work and Lectures in Quantitative Analysis.

Three nights per week of class-room and laboratory work.

IVd. Textile and Analytical Chemistry — 4 Years.

Lectures in Textile Chemistry and Dyeing.

Laboratory Work in Analytical Chemistry.

Combines all lectures in Textile Chemistry and Dyeing with work of Course IVc, but does not include any Dyeing Laboratory. Three nights per week.

TEXTILE ENGINEERING DEPARTMENT.

This department has arranged to offer those courses of study which lie at the foundation of all engineering. These are designed to give to those engaged in the mechanical, electrical, and manufacturing departments of mills, factories and other industrial establishments an opportunity to learn something concerning

the theory underlying the many practical methods which they use in their daily work. Those subjects for which there is usually a regular demand are listed and described below, but similar and allied courses will also be arranged for provided there is a sufficient demand. In the case of all courses there must be an enrollment of at least ten properly qualified students to warrant giving the subject.

VIb. Mechanical Drawing — 3 Years.

For one having occasion to make a sketch or detail drawing for the purposes of illustration or instruction, or for one who is daily required to work from a drawing or blue print, the course in mechanical drawing is offered. It first lays a foundation of the principles of mechanical drawing, and follows this with two years' work in drawing directly from parts of machines, preparing both the detail and the assembly drawing. The time required is two evenings per week.

For detailed description of subject see page 10.

VId. Machine Shop Practice — 2 Years.

This course offers an opportunity to learn the art of metal working and is equally valuable to the man who already has some knowledge of the methods employed as to one who has no knowledge of the same. Thus it becomes possible for one who may be working at the bench during the day to learn how to operate a lathe or other machine tool, or for a lathe hand to acquire a knowledge of a planer, shaper, milling machine, or grinder. A man who only has a knowledge of the special machine which he operates may by means of this course become a more intelligent machinist. He should supplement this study with the courses in Mechanical Drawing, and in Mechanics and Mechanism, in order that his training for an all-round machinist or mechanic may be more complete. The time required is two evenings per week.

For detailed description of subject see page 10.

VIe. Mathematics — 2 Years.

This course is designed to permit the student to pursue further by evening study the mathematics of his grammar or junior high school course. It includes algebra, elementary trigonometry, logarithms and slide rule, and requires attendance for one evening per week. It should be taken by all who intend to study further into engineering subjects. Instruction is largely through problem work in class and at home, and the use of a text book.

For detailed description of subject see page 10.

VIf. Mechanics and Mechanism — 2 Years.

This is one of the most important of engineering subjects dealing as it does with the principles which underlie the transmission of force and motion through machines and mechanical devices. Its principles are so fundamental and so widely used in more advanced subjects that the student should not consider himself qualified for further work until he has mastered the principles of this subject. This subject requires attendance one evening per week with home problem work and the study of a text book.

For detailed description of subject see page 10.

VIg. Strength of Materials — 2 Years.

This interesting subject deals with those important principles whereby the person engaged in machine, engine, mill or building design may ascertain whether the parts are strong enough to carry the forces and loads which the nature of the construction imposes upon them. The time required is one evening per week and the method of instruction is through lectures, recitations, problems, and the use of a text book.

For detailed description of subject see page 10.

VIh. Steam — 2 Years.

It is the purpose of this course to study the various methods of heat generation, transmission, and utilization in use at the present day and to learn the theoretical relationships which underlie these processes and transformations. Text book, laboratory and class work, and home problems are the methods of instruction used, requiring an attendance of one evening per week.

For detailed description of subject see page 10.

VIj. Direct Current Electricity — 2 Years.

This popular course is planned to cover the fundamentals of direct current electricity. The lectures on electrical theory are supplemented by laboratory work and the use of a text book and problems. It requires for its completion attendance for two evenings per week and a considerable amount of home study and preparation.

For detailed description of subject see page 10.

VIk. Alternating Current Electricity — 2 Years.

This course is similar to course VIj except that it deals with alternating current electricity and machinery. No student should plan to take this course unless he has previously taken Course VIj or can show that he has had the equivalent. It is also highly desirable that he have a good knowledge of Mathematics as given in Course VIe. Attendance is required for two evenings per week.

For detailed description of subject see page 10.

FINISHING DEPARTMENT.

VIIa. Cotton Finishing — 1 Year.

VIIb. Woolen and Worsted Finishing — 1 Year.

In these courses machine work is supplemented by lectures and discussions pertaining to the many finishes given to fabrics. The action of soaps, water, steam, heat and cold upon cloth containing one fiber or combinations of fibers as used in commercial fabrics is carefully studied. These courses also help the finisher to broaden his knowledge of textile fabrics.

For detailed description of subjects see page 10.

SUBJECTS OF INSTRUCTION.

COTTON DEPARTMENT.

Cotton Yarns.

Instruction is given by means of lecture and demonstration. The outline of the course is as follows: —

Fiber. — Before taking up the details of the operation of manipulating the fiber into yarn, a careful study is made of the characteristics and classification, both botanically and commercially, of the many varieties of the cotton fiber. Methods employed in cultivating, marketing, grading and stapling are considered, and under these heads a detailed study is made of the types of gin employed.

Opening and Picking. — Instruction in the preliminary operation of opening and picking covers the mechanical construction of the machines, their parts and adjustments, as fully as the manufacturing results accomplished by the machines. This includes such construction details as evener, lap measuring and safety stop motion, grids, cleaning trunks, beaters, etc.; also operation details which involve the adjustment of waste, drafts and character of laps.

Carding. — The process of carding is considered one of the most important, and propet time is devoted to the construction and operation of cards that the student may be familiar with the various parts of the card and the function and design of each. The construction and application of card clothing, as well as the methods of grinding, form a part of the work.

Drawing. — Under this head is taken up the theory of doublings and their effect upon the quality of roving and yarn. Like previous and subsequent processes the machine construction forms an important part of the work. Proper stress is paid to such subjects as stop motions, drawing rolls and their covering, cleaners and evener motions.

Roving Processes. — Under this head are studied the various machines known as the slubber, intermediate, fine and jack fly frames. The relative motion of the various parts of these machines is so complex that a good opportunity is here presented to fix in the student's mind the application of certain mechanical principles that are used in other departments and upon other machines in the manufacture of textile material. With each process of yarn manufacture are explained the sys-

tems of sizing and numbering, and under this head are taken up both the metric and English systems.

Ring Spinning and Twisting. — The consideration of spinning yarn by the ring frame method involves a knowledge of the uses to which the yarn is to be put, subsequent methods of handling that proper roving may be selected, suitable amounts of draft and twist provided, correct size of rings and travelers selected, building motions suitably adjusted, etc. The operation of twisting yarns is so closely related to spinning by the ring method that it is studied at the same time. This opens an almost limitless field of novelty yarn manufacture, and offers a very good opportunity to derive new types of yarn or new mechanism to produce the effects. Yarn defects are studied with reference to the cause and remedy.

Mule Spinning. — This method of spinning is very different from that of the ring frame, and the mechanical details are more complicated. The student is furnished with new means of producing yarns, and can compare the relative advantage of each method. A thorough understanding of mule spinning is perhaps more a study of mechanical motions and their functions. This results almost invariably in assisting the student to understand previous processes and machines better because of his work on the mule. It is the object to make clear to the student's mind the principles underlying the construction and operation of the parts that control the drawing, twisting, backing off, winding, together with such special motions and devices as are used upon the modern mule.

Combing. — This process is explained by lecture work and by operation and assembling of the various types of combs in service in the laboratory. The object of combing is fully considered, and the different means employed on the many types of combers on the market are studied. This includes such types as the Heilman, New Whitin and Nasmith combers.

WOOLEN AND WORSTED DEPARTMENT.

Woolen and Worsted Yarns.

Raw Materials. — A study of raw materials which enter into the manufacture of woolen or worsted yarns, or are made into yarns by processes similar to those employed in the manufacture of woolen and worsted yarns, would include silk, mohair, alpaca, vicuna, cashmere, camel's hair and cotton. In connection with these are considered shoddy, noils and extracts.

Wool Sorting. — Familiarity with the various grades and kinds of wool is obtained by lecture. The various characteristics and properties are explained, as are also trade terms, such as picklock, XXX, XX, $\frac{1}{2}$-blood, $\frac{3}{8}$-blood, $\frac{1}{4}$-blood, delaine, braid, etc. Some skill is acquired in the estimation of shrinkage and in judging the spinning qualities.

Wool Scouring. — The object of scouring and the methods employed are explained, and this involves the consideration of the soaps and chemicals used in washing; also the waste products and their utilization. Actual work is done in scouring a commercial quantity of wool by machines that are made similar in operation to regular commercial machines. A study is made of the effect of the hardness of water upon soap. At the same time the use of driers, their operation and regulation, is taken up, and the methods of carbonizing wool, noils, burr waste, rags, etc., are studied and explained.

Burr Picking, Mixing, Oils and Emulsions. — The use of burr pickers in cleaning wool and the use of mixing pickers in making color blends is covered by lecture and demonstration. Under the subject of oil and emulsions are taken up the characteristics of various oils and the means employed to test them.

This work is taken only by those students who are pursuing the Woolen Manufacturing Course.

Carding. — The different systems of carding wool, depending on whether it is to be made into woolen or worsted yarns, are fully explained, as is also the construction, setting and operation of cards. A part of this work consists of a study of card clothing, its construction, application and grinding.

Woolen Mule. — The student studies thoroughly the operation of the mule as a whole, and acquaints himself with the various principal mechanisms, as, for example, the backing off and winding motions, the quadrant, builder-rail, faller regulation, etc.

Top Making and Combing. — This branch takes up, besides the carding of the wool on a worsted card, the preparing processes, backwashing, also gilling of the stock before and after combing. The construction of the gill boxes and combs is studied by lectures. Later, quantities of stock are made into top and then into yarn.

The Noble, Lister and French combs are studied, and the various calculations to determine draft, noiling, productions, etc., are made.

Drawing and Spinning. — The equipment in the laboratory offers opportunity to make worsted yarn by either the Bradford or open drawing system or by the French system. The process includes the various machines in the successive steps of making Bradford spun yarn, and the functions of the different machines are studied. In the latter, or French system, the stock is run through the drawing machines, and the roving spun into yarn on the worsted mule. The same method of studying the mechanism and operations of these machines is followed as in the case of previous methods of instruction. The student by pursuing this course can compare the different methods of yarn manufacture and note the results of each.

With the instruction in spinning by the Bradford system is given work on the twisters and the effects that may be produced.

TEXTILE DESIGN AND WEAVING DEPARTMENT.

Textile Design.

During the first year instruction is given in the subject of classification of fabrics, use of point or design paper, plain fabrics, intersection, twills and their derivation, sateen, basket and rib weaves, checks and stripes, fancy weaves, including figured and colored effects; producing chain and draw from design, and *vice versa;* extending and extracting weaves.

For Cotton Goods.

During the second year consideration is given to fancy and reverse twills, diaper work, damasks, skip weaves, sateen fabrics with plain ground, backed fabrics, and multiple ply fabrics. Students are required to make original designs. Special attention is given to the consideration of color effects.

The analysis of these fabrics forms a part of the course in design. This also includes the necessary calculations required to reproduce the fabric or to construct fabrics of similar character.

For Woolen and Worsted Goods.

During the second year the instruction given includes warp and filling backed cloth, figured effects produced by extra warp and filling, double cloths, multiple ply fabrics, cotton warps, blankets, bath robes, crêpes, filling reversible, Bedford cords, imitation furs, crêpons, matelasse and imitations, double plain, ingrains, velvets, corduroys, overcoatings, trouserings.

The analysis of these fabrics, together with the consideration of the shrinkages and dead loss in all fabrics, theory of diameter of yarns, and costs of mixer blends, is a part of this course.

The advanced work takes up the more complicated weaves adapted to harness work, and leads into leno and Jacquard designs. The following is a brief list of the subject heads, which will give some idea of the course: double plain cloths, ingrains, tricots, chinchilla, tapestry, blankets, upholsteries, spot weaves, pile or plush, crêpon, matelasse and its imitations, piqué, marseilles, quilting and miscellaneous designs for Jacquard, leno, fustian, tissue fabrics and lappets.

Cloth Analysis.

In the first year this subject takes up in a systematic manner the analysis of samples illustrating the various cloth constructions for the purpose of determining the design of the weave and the amount and kind of yarns used, and forms the basis of calculation in the cost of reproducing any style of goods. The various topics discussed are reeds and setts; relation and determination of counts of cotton, woolen, worsted, silk and yarns made from the great variety of vegetable fibers; grading of yarns, folded, ply, novelty and fancy yarns; application of the metric system to yarn calculation; problems involving take-up, average counts, determination of counts of yarn, and weight of yarn required to produce a given fabric.

Cloth Construction.

The work includes the application of the different weaves and their combinations in the productions of fancy designs, both modified and original; the calculation involved in the reproduction of standard fabrics changed to meet varying conditions of weight, stock, counts of yarn and value.

Instruction in this subject, which is given by classroom work, is intended to bring together the principles considered under the subject of design, cloth construction, weaving and yarn making of previous years, and to show the bearing each has in the successful construction of a fabric.

Power Weaving.

Instruction in cotton weaving is carried on upon power looms in connection with the work in Textile Design and Cloth Analysis. This includes a study of the preparation of warps, beaming, dressing, sizing, drawing-in and making of chains, the cutting and lacing of cards, spooling and quilling and the machinery for the same. A study is made of warpers and sizing machines, both for cotton and woolen. Lectures are given to correspond with the progress of the student in the Power Weaving Laboratory covering the following subjects: loom adjustments, chain building, shuttle changing looms, dobby looms, single and double acting dobbies, handkerchief motions, leno weaving, center selvedge motions, filling changing looms, oscillating reeds, lappet motions, various shaker motions, towel and other pile cloth weaving, Jacquard looms, single and double lift leno Jacquards, Jacquards of special design, tying up Jacquard harness. Instruction is also given in weaving on fancy woolen and worsted looms.

Cotton Weaving.

The course in Cotton Weaving covers instruction on plain looms, Draper Automatic looms, and also on the Stafford Automatic looms. It includes instruction on the construction of shedding and picking motions, take-up and let-off motions together with the operation of the magazines and hoppers and methods of changing shuttle and bobbin. Instruction is also given on the Crompton and Knowles Automatic Towel Looms and the various types of box looms, including chain building and work on multipliers.

Woolen and Worsted Weaving.

This course includes instruction on the Crompton and Knowles loom and takes up general construction, head motions, take-up, let-off, filling stop motion, etc. The course also includes warp preparation.

Dobby and Jacquard Weaving.

This course considers the various types of Jacquard heads and dobbies, which includes single cross border dobbies and leno attachments on double lift dobbies. The course on Jacquard looms includes general construction and card cutting, lacing, repeating, and fixing.

CHEMISTRY AND DYEING DEPARTMENT.

General Elementary Chemistry (Inorganic and Organic Chemistry).

Instruction in Elementary Chemistry extends through two years, and includes lectures, recitations and a large amount of individual laboratory work upon the following subjects: —

THEORETICAL CHEMISTRY. — Chemical action, chemical combination, combining weights, atomic weights, chemical equations, acids, bases, salts, Avogadro's law, molecular weights, formula, valence, periodic law, etc.

NON-METALLIC ELEMENTS. — Study of their occurrence, properties, preparations, chemical compounds, etc.

METALLIC ELEMENTS. — Study of their occurrence, properties, metallurgy, chemical compounds, etc.

The students take up, as thoroughly as time will permit, the qualitative detection of the more common metals and non-metals, with practical work.

This work, although necessarily elementary, is intended to prepare the student to more understandingly study the manufacture of dyestuffs and coal tar colors in the more advanced courses which follow.

Qualitative Analysis.

The laboratory work during the second year of the Elementary Chemistry course consists entirely of Qualitative Analysis. While this course is necessarily taken up in an abbreviated and elementary manner, it is so arranged that the students may become familiar with the separations and the detections of the common metals and acids. This course is also preliminary to the work given in Analytical Chemistry.

During the first year of the Elementary Chemistry course most of the time will be devoted to the non-metals and theoretical chemistry, and the laboratory work will be briefly upon the non-metals.

During the second year the classroom work will be upon metals and the hydrocarbons and their derivatives, and the laboratory work will be qualitative analysis.

Textile Chemistry and Dyeing.

The outline of the lecture course given in Textile Chemistry and Dyeing is as follows: —

Technology of Vegetable Fibers. — Cotton, linen, jute, hemp, china grass. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Animal Fibers. — Wool, mohair, silk. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Artificial Fibers. — Study of the various forms of artificial silk, the process of manufacture, their properties and action with chemicals, acids and heat.

Operations preliminary to Dyeing. — Bleaching of cotton and linen; wool-scouring; bleaching, fulling and felting of wool; carbonizing; silk-scouring and bleaching; action of soap.

The bleaching of cotton is studied with description of the various forms of kiers and machinery used; also the action of the chemicals used upon the material, and the various precautions that must be taken in order to insure successful work.

Under this heading is included a study of the reagents used in the emulsive wool-scouring process, and their action upon the fiber under various conditions; also the most successful of the solvent methods for degreasing wool.

Water and its Application in the Textile Industry. — Impurities present methods for detection, their effect during the different operations of bleaching, scouring, dyeing and printing, and the methods used for their removal or correction.

The important subject of boiler waters is also studied under this heading, with a full discussion of the formation of boiler scale, its disastrous results, and the methods by which it may be prevented.

Mordants and Other Chemical Compounds used in Textile Coloring, and classified as Dyestuffs. — Theory of mordants, their chemical properties and application, aluminum mordants, iron mordants, tin mordants, chromium mordants, organic mordants, tannin materials, soluble oil, fixing agents, leveling agents, assistants, and numerous other compounds not dyestuffs that are extensively used in the textile industry.

Under this heading are included the definitions of various terms and classes of compounds used by textile colorists, such as color lakes, pigments, fixing agents, developing agents, mordanting principles and leveling agents.

Natural Organic Coloring Matters. — Properties and application of indigo, logwood, catechu or cutch, Brazil wood, cochineal, fustic, turmeric, madder, quercitron bark, Persian berries, and other natural dyestuffs that have been used in recent years by textile colorists.

Mineral Coloring Matters. — Under this heading are discussed the properties of such inorganic coloring matters and pigments as chrome yellow, orange and green, Prussian blue, manganese brown, iron buff.

Artificial Coloring Matters. — General discussion of their history, nature, source, methods of manufacture, methods of classification and their application to all fibers.

Special study of basic coloring matters, phthalic anhydride colors, including the eosins and phloxines; acid dyestuffs, Janus, direct cotton, sulphur and mordant colors, including the alizarines and other artificial coloring matter requiring metallic mordants; mordant acid and insoluble azo colors, developed on the fiber; reduction vat colors, aniline black and other artificial dyestuffs not coming under the above heads.

As each class of dyestuffs is taken up the details of the methods of applying them upon all the different classes of fabrics and in all the different forms of dyeing machines are thoroughly discussed; also the difficulties which may arise in their application, and the methods adopted for overcoming them.

Machinery used in Dyeing. — A certain amount of time is devoted to the description of the machinery used in the various processes of textile coloring, which is supplemented as far as possible by the use of charts, diagrams and lantern slides.

During the third year of this course, if time permits, the more advanced subjects of union dyeing, textile printing, dye testing, color matching and color combining will be briefly considered.

Dyeing Laboratory.

Besides lectures and recitations upon the subject of Textile Chemistry and Dyeing, practical laboratory work is required. By the performance of careful and systematic experiments the student learns the nature of the various dyestuffs and mordants, their coloring properties, their action under various circumstances, and the conditions under which they give the best results. The more representative dyestuffs of each class are applied to cotton, wool and silk, and each student is obliged to enter, in an especially arranged sample book, a specimen of each of his dye trials with full particulars as to the conditions of experiment, percentage of compounds used, time, temperature of dye bath, etc.

For convenience and economy most of the dye trials are made upon small skeins or swatches of the required materials, but from time to time students are required to dye larger quantities in the full-sized dyeing machines.

Analytical Chemistry.

The object of this course will be to give the student a general idea of the underlying principles of Analytical Chemistry, with a sufficient amount of laboratory work to enable him to become proficient in performing the ordinary routine analysis of the textile plant. Frequent recitations will be held for the discussion of methods and the solution of stoichiometrical problems.

The work covered the first two years is based on Smith's "Quantitative Analysis," and for the advanced work, consisting of the analysis of soap, water, oils, cloth and other materials of particular interest to the textile chemist, special lecture notes and Griffin's "Technical Methods of Analysis" is used as a text.

TEXTILE ENGINEERING DEPARTMENT.

Mechanical Drawing.

This course is a complete course in drawing and requires two evenings per week for three years for its completion. The work in this course is so planned that at its completion a man shall be thoroughly familiar with the making of a working or shop drawing. After a study of the underlying principles of projections and instruction in penciling, inking, lettering and tracing, the subject of sketching and the making of detail drawings therefrom is especially stressed. The preparation of assembly drawings is finally considered. Shop mathematics is a prerequired subject.

Machine Shop Practice.

This course is one in which by actual practice the student learns the use and possibilities of such machine tools as the lathe, milling machine, shaper, planer, and grinder. This is supplemented by a series of lectures on their care and management, tool grinding, and the mechanism of the machines.

Mathematics.

This subject is a continuation of the work described under Shop Mathematics, and is intended as a foundation for the more advanced courses in engineering. Some of the topics treated are —

Elementary algebraic operations of —

Addition.	Graphical representation.
Subtraction.	Linear equations.
Multiplication.	Radicals.
Division.	Logarithms.
Factoring.	Slide rule.
Fractions.	Trigonometry.

Mechanics and Mechanism.

Beginning with a discussion of such important topics as work, power, horsepower, energy and the like, the student then studies the fundamental mechanical principles which are exemplified by the lever, jackscrew, pulley block, inclined plane, wedge, differential pulley and other similar devices. This is followed by consideration of the simpler relations pertaining to uniform and accelerated motion and the course concludes with a study of pulleys, belting, gears and gearing, as far as time permits. No student should undertake this course who is not thoroughly familiar with such elementary mathematics as is described under Shop Mathematics.

Strength of Materials.

The fundamental stresses of tension, compression and shear are first considered, together with the ultimate strength of cast iron, wrought iron, steel, and timber. The practical use of this information is illustrated in the design of bolts, tie rods, columns, wall piers, boiler shells, riveted joints, etc. This is followed by a study of the stresses in and design of beams under various conditions of loading, and the course concludes with a discussion of the torsional stresses and twist in shafts. A knowledge of the principles of Mechanics and Mechanism is highly desirable to a satisfactory understanding of this subject.

Steam.

The instruction in this subject covers, so far as time permits, the elements of steam engineering. The topics covered are heat and its measurement, use of steam tables, types of boilers, engines and turbines, boiler and engine room accessories, together with a study of the methods of testing the various types of apparatus. Actual tests on such equipment are made as the size of the class permits.

Direct Current Electricity.

The fundamental properties of electrical and magnetic circuits are studied under this subject both in the class-room and laboratory. Other topics include the measurement of resistance, the calculation and measurement of power in direct-current circuits, and the relation between the electrical, heat and mechanical units of energy. The design and operation of direct-current motors and generators are next studied in the class-room and laboratory. A large amount of laboratory work is given to make the student familiar with methods of testing and controlling electrical machinery.

Alternating Current Electricity.

A thorough knowledge of the theory and application of direct-current electricity is required before taking up this subject. Alternating current circuits are first studied, and then the design and operation of alternating current machinery are taken up. Some time will be devoted to the study of illumination and electrical measuring instruments. The instruction is given by means of lectures, recitations, and a large amount of laboratory work.

Shop Mathematics.

By this topic is meant the practical application of arithmetic, geometry and algebra to everyday problems. It includes briefly, addition, subtraction, multiplication, division, common and decimal fractions, ratio and proportion, common areas and volumes, and simple equations involving one unknown.

FINISHING DEPARTMENT.

Woolen and Worsted Finishing.

The outline of this course, which is given chiefly by means of lecture work, is as follows: —

Burling and Mending. — Under this head are taken up for consideration the examination of flannel as it comes from the loom; the construction, use and location of the perch: the methods used in marking defects, measuring, weighing and numbering of cloths; also the methods of inspection for fancies, single cloths and double cloths. The object of burling, mending and the types of tables employed, the method of removing knots, runners, etc., the object of back shearing and the use of burling irons, the replacing of missing threads and the importance of sewing as a part of the finishing process, are all considered in detail. The removal of oil and tar spots as well as stains of various kinds is studied.

Fulling. — This branch covers a study of the conditions of the flannel as it comes from the loom, and the influence of oil, etc., upon the procedure. Considerable time is devoted to the various methods of producing a felt, the early types of stocks, hammer falling and crank stocks, and their modifications and development into the present type of rotary fulling mills of both the single and double variety. The details of construction in all machines are carefully taken up and include the design and composition of the main rolls, methods of covering, regulation and means of adjusting the pressure of traps and rolls, consideration of the shoes, the use and regulation of the various types of stop motion, the different types of stretchers, guide rolls and throat plates.

The theory of felt is taken up and the influence of pressure, moisture, heat, alkali and acid is considered, as well as the hydroscopic and felting properties of different wool fibers. The preparation of the flannel for the mill and the usual methods of determining shrinkages, as well as the various methods of soaping, are given careful attention. The preparation of various fulling soaps and the value of each for the production of various degrees of felt, as well as the determination of the proper amount of alkali for various goods, are carefully studied and demonstrated. The manipulation of the various kinds of goods in the mill, viz., all wool, shoddies and mixed goods, is studied in classroom and by operation in the mill.

The change in weight and strength for each operation is carefully considered, as is also the value of the flocks made in each. A study of the various methods of flocking, such as dry and wet, is considered in both class and machine rooms. In each operation the defects likely to materialize are studied, as well as the cause thereof, and various methods of modifying or lessening them.

Washing and Speck Dyeing. — This branch considers the scouring, rinsing and washing of goods both before and after the fulling process; the various types of washers; and the details of construction, such as suds box, rolls, etc. The theory of scouring, uses of Fuller's earth, salt solutions and sours on the different kinds of goods are made clear by practical work in the machine room, where the effects due to improper scouring, such as stains, cloudy effects, wrinkles and unclean goods, are demonstrated. The discussion of the necessity of speck dyeing follows naturally from the study of these matters, and includes methods of preparation, materials used, application and tests required.

Carbonizing. — This is an important branch of finishing, and includes a study of the various carbonizing agents, methods of application, strength of solutions and neutralizing, as well as the machines used. Stains and imperfections resulting from carbonizing are also considered. The drying and tentering machines and extractors employed are taken up at this point.

Gigging, Napping and Steaming. — The construction in detail of the various types of gigs, nappers, steamers, wet gigs, rolling, stretching, crabbing and singeing machines is discussed, and their actions upon the cloth and the results obtained are explained.

Various methods of obtaining luster and the production of permanent finish are considered in connection with steaming and sponging.

Brushing, Shearing and Pressing. — This includes, as do the other branches, a careful treatment of the machine employed, the preparation of the cloth for each process, the action of each machine in producing its part of the resultant effect.

In manipulation of the shear consideration is given to its setting, grinding and adjustment. With the brushing machine the effect of steaming and moisture upon the luster and feel of the goods is shown. A study of the action of the presses, both plate and rotary, involves consideration of pressure, steaming, etc. Special processes to obtain particular effects are taken up, and the part played by each machine is explained. The details involved in handling cloth on a commercial scale, as, for example, measuring, weighing, ticketing, numbering and rolling, are also explained. The necessary calculation and the methods of finishing all grades of goods are considered from time to time during the year.

Cotton Finishing.

The outline of the course in the finishing of cotton fabrics is as follows: —

Cloth Room. — Instruction of the various goods and the object thereof; construction of the various types of inspecting and trimming machines.

Shearing. — The object. A consideration of the various types of shears for treating one or both sides at the same time; also the use of the usual cleaning devices, such as emery, sand and card rolls, beaters and brushes; grinding and the adjustment of the various parts.

The use of brushing and cleaning machines, rolling devices and calender attachments for gray goods.

Singeing. — Developing and object of singeing; the construction of singers of all types, and for various purposes; the use of cooling tanks, steaming devices, rolling and brushing attachments.

Regulation of the flame for various goods, and adjustment of the parts; gas and air pressure, water-cooled rolls; the effect of moisture on the cost of singeing; the use of dry cans in connection with singeing; electric singeing.

Washing. — Open width and string washers, their construction and operation; soaps, temperature, squeeze rolls; washing of various goods and the object thereof; stains.

Napping. — The object of napping and the usual method of treating goods; various types of nappers, single and double acting; felting nappers; construction, grinding and adjustment of various types.

Water Mangles. — Their object and the construction of various types; various rolls, — iron, husk, etc.; scutchers, their object and constructions.

Starch Mangles. — The object and construction of all types of starch mangles for pure starch and filled goods; various types of rolls, — brass, rubber, wood; action of doctor blades, etc.; regulation and object of pressure.

Methods of starching and finishing all standard goods, also a consideration of the various substances used, such as starch, softener and fillers; the preparation of starch and various methods of application.

Dryers and Stretchers. — Both horizontal and vertical, tenter frames, clips; the swing motion and the finishes thus produced; construction; spraying machines, belt stretchers, button breakers; their object and construction.

Calenders. — The object and construction of all types, including the regulation of pressure and nips for the production of various finishes; various types of rolls and their uses, — steel, husk and paper; the use of hot and cold rolls; chasing, friction, embossing and Schriner calenders and the various finishes produced by each; production of watered effects; beetling machines.

Making up room, — yarding, inspecting; different types of folds; pressing, papering, marking.

EVENING GRADUATES OF 1926.

Certificates awarded as follows, April 8, 1926: —

Course I (Cotton Manufacturing) — 4 Years.

Charles Jesse Allgrove, Jr. . . . . Tyngsborough, Mass.

Course Ia (Cotton Yarns) — 3 Years.

Arthur Henry Monty . . . . Lowell, Mass.
Cornelius Paul Murphy . . . . Lowell, Mass.
Philippe Paradis . . . . Lowell, Mass.
George William Stewart . . . . Lowell, Mass.

Course Ib (Knitting) — 1 Year.

Marshall Sawyer Floyd	Waltham, Mass.
George Sotnick	Lowell, Mass.

Course II (Woolen Manufacturing) — 4 Years.

Melvin Seth Crosby	Reading, Mass.
Philip Maurice Philbin	Lowell, Mass.

Course IIa (Woolen Yarns) — 2 Years.

Henry Black	Lawrence, Mass.

Course IIb (Worsted Yarns) — 2 Years.

Frederick William Gatenby	No. Chelmsford, Mass.
James Harrington Kennedy, Jr.	Methuen, Mass.
Richard Edward Picking	Lowell, Mass.
Allen Batterman Smith	Lowell, Mass.

Course IIIa (Cotton Design) — 3 Years.

Raymond Alexander Bonnin	Lowell, Mass.
Thomas Joseph Fitzgerald	Lowell, Mass.
Herbert Higginbottom	Lowell, Mass.

Course IIIb (Woolen and Worsted Design) — 3 Years.

Henry Black	Lawrence, Mass.
Daniel Joseph Collins	Lowell, Mass.
James Hay Cuthill	Andover, Mass.
Thomas John Hannagan	Lawrence, Mass.
William Higgins	Lawrence, Mass.
George Bertram Hyde	Lawrence, Mass.
John Leo Keleher	No. Billerica, Mass.
Raymond James Schuster	Methuen, Mass.
Lloyd Kenison Sharples	Haverhill, Mass.
John Hopwood Wilson	Methuen, Mass.

Course IIIc (Freehand Drawing) — 3 Years.

Edward Francis Blinkhorn	Lowell, Mass.
Wasaburo Inowoka	Lowell, Mass.

Course IVa (Elementary Chemistry) — 2 Years.

James Watson Breckenridge	Lowell, Mass.
Harry Oscar Carlson	Lowell, Mass.
Theodore Roosevelt Hardman	Lowell, Mass.
Henry Francis Kane	Lawrence, Mass.
Oswald Henry McClay	Boston, Mass.
John Thomas Parsons	Lowell, Mass.
Adrian Perrault	Lawrence, Mass.
Wilfred Irving Racicot	Lowell, Mass.
Lawrence Elbridge Remick	Braintree, Mass.
William Elliott Small	Haverhill, Mass.

Course IVb (Textile Chemistry and Dyeing) — 3 Years.

Richard John Andreoli	Lowell, Mass.
Stephen Francis Howard, Jr.	Lowell, Mass.

Course IVc (Analytical Chemistry) — 3 Years.

Thomas Edward Torpey	Lowell, Mass.

Course IVd (Textile and Analytical Chemistry) — 4 Years.

John Diggle Thomson	Lawrence, Mass.

Course Va (Cotton Weaving) — 1 Year.

Clinton Roger Andrews	Andover, Mass.
Raymond Alexander Bonnin	Lowell, Mass.
Philip Fairbairn Coburn	Nashua, N. H.
James Patrick Fitzgerald	Lowell, Mass.
Daniel Claude Lynch	Lowell, Mass.
Alfred Whitham	Lowell, Mass.

Course Vb (Woolen and Worsted Weaving) — 2 Years.

Henry Banks	Lawrence, Mass.
William Arthur Baxter	Methuen, Mass.
Edwin Hey	Lowell, Mass.
George Bertram Hyde	Lawrence, Mass.
Arthur William Meister	Methuen, Mass.
Harold Ballard Walker	Ballardvale, Mass.

Course Vc (Dobby and Jacquard Weaving) — 1 Year.

Alfred George Baron	Lowell, Mass.
Raymond Alexander Bonnin	Lowell, Mass.
Raymond Gates Flanders	Nashua, N. H.

Course VIb (Mechanical Drawing) — 3 Years.

Joseph Cleophas Chenette	Lowell, Mass.
Francis Raymond Coleman	Lowell, Mass.
Thomas Edward Donaghue	Lowell, Mass.
Timothy Walter Garrity	Lowell, Mass.
Alexander Joseph Hanna	Methuen, Mass.
Elliot Chadwick Perrin	Lowell, Mass.

Course VId (Machine Shop) — 3 Years.

Wilfred Edward Gionet	Lowell, Mass.

Course VIIa (Cotton Finishing) — 1 Year.

Bliss Anderson Bowser	Lowell, Mass.
Lewis Bradford Diman	Lowell, Mass.
Elwyn Everett Dow	Nashua, N. H.
Richard Henry Ralph	Lowell, Mass.
Roswell Wheeler Sadd	Nashua, N. H.

Course VIIb (Woolen and Worsted Finishing) — 1 Year.

Henry Black	Lawrence, Mass.
Edwin Adolf Buthmann	Lawrence, Mass.
Arthur Dixon	Methuen, Mass.
James Hay Cuthill	Andover, Mass.
Edward Joseph Goldrick	Lowell, Mass.
Thomas John Hannagan	Lawrence, Mass.
George Ernest Herzog	Lawrence, Mass.
William Higgins	Lawrence, Mass.
George Bertram Hyde	Lawrence, Mass.
Maurice Jones	Lawrence, Mass.
John Leo Keleher	No. Billerica, Mass.
Carl Lester Lofgren	Lawrence, Mass.
James Arthur Mellor	Lawrence, Mass.
Harold Lawrence Richardson	Methuen, Mass.
Raymond James Schuster	Methuen, Mass.
Harold Ballard Walker	Ballardvale, Mass.
John Hopwood Wilson	Methuen, Mass.
Edmund Hugo Zacharias	Methuen, Mass.

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PHOTOMICROGRAPHS AND THEIR ADVANTAGES

By A. K. Johnson, S. B., *Instructor in Chemistry.*

Seeing is believing! How obviously true in the land of the visible and how fascinatingly and helpfully true in the region of those objects and details, commonly indistinct or invisible to the naked eye, when brought to clear vision by use of the microscope! What a blessing and help are the visual revelations of the microscope to the initiated textile worker enforced to study and interpret conditions (normal or abnormal) upon fine or lustrous yarns, knitted or woven materials, fibers, and a host of other kinds of fine or close work!

A typical example of this is found in the following inquiry that accompanied a certain fabric. "What did you find out about that streaked cloth which I left here yesterday; that fine white cloth, beautiful, soft, and lustrous, good to look at, but with those prominent, over-lustrous streaks bunched together in places and running in the direction of the filling?"

The reply was — "If you look at the streaks under this microscope you can see things as they are."

"But I can not see anything through one of those microscopes. Everything gets in the way, specks in the eyes, eyelashes, nose and what not, and when I can see, I don't know it. If you could give me the sights without the instrument being in the way, then I believe I could talk business with appreciation of the facts."

To this came the reply, "We can discuss this matter better over a photomicrograph than over a microscope. Here is a photomicrograph of the cloth, at a magnification of 11½ diameters." (See Fig. 1.)

"Where is the streak? This condition of things is not what I had preconceived in my mind. Tell me about it."

"The black spot on the right-hand edge is not a thumb mark but is the picture of a pencil dot placed on the cloth to mark the bounding line between the normal-appearing area and the streaked area. The portion on the picture above the dot shows the normal appearance, while that below the dot is the streaked. If we were to study every such streak, we would find similar appearances to those prevailing here. The cotton warp, which is easily seen to be double, runs up and down in the picture, the rayon filling goes across the picture. Observe the prominent, black, open spaces in the streaked area, and their practical absence in the normal area, where the position of every thread, relative to other threads is clearly visible and shows no error. The general condition of each thread is manifestly good, with no chafing, no cuts, bruises or spreading evident. The cotton warp threads appear to be the same in the two sections, although there are evident (allowable) variations in the diameter of one with respect to another. The cause of the open spaces therefore must have some connection with the filling."

"Now let us measure with dividers the width covered by the rayon in the normal area, at a point close to its passing under the warp and compare the measurements with the scale (Fig. 1) which gives the size of millimeter divisions at the same magnification. The normal area shows values of 1.0, 0.7, 0.85, 0.7, 0.9, averaging 0.83 mm. in diameter. Those threads from the streaked area show 0.9, 0.88, 0.6, 0.6, averaging 0.7 mm. The openings between threads in the streaked area show values at one place of 0.2 mm. for each space, whereas the openings between threads in the normal part are largely negligible. It is thus readily seen that the trouble has for its fundamental cause, the failure of the rayon filling to fill the area allotted to it. The subsequent result is that the light is reflected by the highly lustrous surfaces of the upper part in a different manner than it is in the streaked area."

These conditions are much more apparent from the microscopic photograph than from the cloth itself when viewed with the naked eye. For one who is unaccustomed to the use of the microscope the ease of examination and study is much more easily done through the photograph than by actual observation through the instrument.

It will be noted also that the microscopic information of this fabric is now permanently available at any instant and in any place where one may wish to carry it. No longer is there any need for fabric, microscope, or accessories. The picture may be taken from the files and you have the recorded information. From the negative

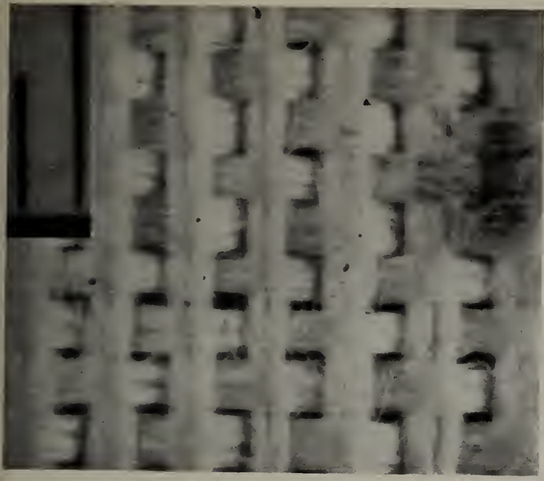

Fig. 1

Fig. 2

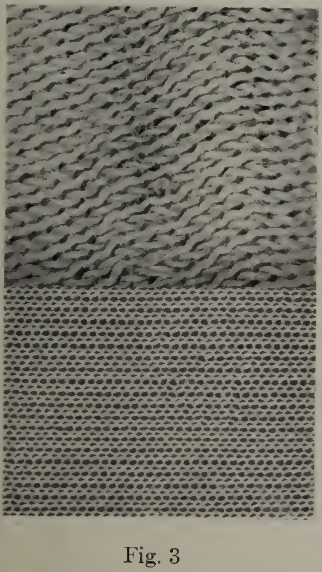

Fig. 3

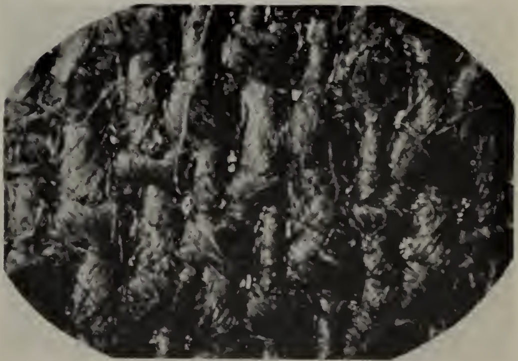

Fig. 4

of this picture, prints in any number, in any size of enlargement or reduction can be made. The information may be transferred to lantern slides or made of service in any form known to commercial photography, for purposes of demonstration, education, research, or reproduction."

There are numerous other instances where the values of microscopic information become of service. For example — Figure 2, Cloth Before and After ~~Shiner~~ Schreiner Calendaring. The physical impressions of the lines on the rolls are easily seen and measured. By using a cross sectional view of the fabric, that is, cutting the cloth in a plane perpendicular to the long axis of the threads and then photographing, other valuable data may be obtained.

Figure 3 is a view of a piece of knit goods, but with a different degree of magnification.

Figure 4 illustrates the reflection of light from different parts of the threads of a brown cotton tailor press cloth.

Photomicroscopy, thus clinches in black and white upon the negative, the valuable microscopic characteristics seen in the field of the microscope. It clinches them accurately, reliably, and permanently, and in a form of record which lends itself easily to any discussional or educational method of use which is desired. And, best of all, it presents the information in a physical and psychological manner that can not be surpassed for simplicity, convenience, and definiteness in use. These are the inherent advantages of the photomicrograph over visual microscopy.

NOTE. — All photomicrographs made in the Photomicrographic Laboratory of the Lowell Textile School.

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February, 1927

BULLETIN

OF THE

Lowell Textile School

LOWELL, MASS.

Issued Quarterly

1927

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CALENDAR.

1926–1927

September 16–17, Thursday–Friday . .	Entrance Examinations.
September 20–25, Monday–Saturday . .	Re-examinations.
September 23, Thursday 9.00–12.00 A.M. .	Registration for Freshmen.
September 27, Monday	Registration for upper class students.
September 28, Tuesday	First term begins.
October 12, Tuesday	Columbus Day — Holiday.
November 23, Tuesday 4.30 P.M. . . .	Thanksgiving recess begins.
November 29, Monday 9.00 A.M. . . .	Thanksgiving recess ends.
December 21, Tuesday 4.30 P.M. . . .	Christmas recess begins.
January 3, Monday 9.00 A.M.	Christmas recess ends.
January 24, Monday	First term examinations begin.
February 4, Friday	End of first term.
February 7, Monday	Second term begins.
February 22, Tuesday	Washington's Birthday — Holiday.
April 15, Friday 4.30 P.M.	Spring recess begins.
April 20, Wednesday 9.00 A.M.	Spring recess ends.
May 23, Monday	Second term examinations begin.
May 30, Monday	Memorial Day — Holiday.
June 7, Tuesday	Commencement.
June 9–10, Thursday–Friday.	Entrance Examinations.

1927–1928

September 15–16, Thursday–Friday . .	Entrance Examinations.
September 19–24, Monday–Saturday . .	Re-examinations.
September 21, Wednesday 9.00 A.M. . .	Registration for Freshmen.
September 26, Monday	Registration for upper-classmen. Classes begin for Freshmen.
September 27, Tuesday	Classes begin for upper-classmen.
October 12, Wednesday	Columbus Day — Holiday.
November 22, Tuesday 4.30 P.M. . . .	Thanksgiving recess begins.
November 28, Monday 9.00 A.M. . . .	Thanksgiving recess ends.
December 16, Friday 4.30 P.M.	Christmas recess begins.
January 3, Tuesday 9.00 A.M.	Christmas recess ends.
January 23, Monday	First term examinations begin.
February 3, Friday	End of first term.
February 6, Monday	Second term begins.
February 22, Wednesday	Washington's Birthday — Holiday.
April 18, Wednesday 4.30 P.M.	Spring recess begins.
April 23, Monday 9.00 A.M.	Spring recess ends.
May 21, Monday	Second term examinations begin.
May 30, Wednesday	Memorial Day — Holiday.
June 5, Tuesday	Commencement.
June 7–8, Thursday–Friday	Entrance Examinations.

TRUSTEES OF THE LOWELL TEXTILE SCHOOL.

OFFICERS OF INSTRUCTION AND ADMINISTRATION.

Charles Holmes Eames, S.B., Billerica.
President.

Louis Atwell Olney, S.B., M.S., Sc.D., 118 Riverside Street.
Professor of Chemistry; in charge of Department of Chemistry and Dyeing.

Edgar Harrison Barker, 9 Mount Hope Street.
Professor of Textiles; in charge of Department of Wool Yarns.

Arthur Andrew Stewart, 56 Robbins Street.
Professor of Textiles; in charge of Department of Finishing.

Hermann Henry Bachmann, 146 Parkview Avenue.
Professor of Textile Design; in charge of Department of Design and Weaving.

Lester Howard Cushing, A.B., 10 Walden Street.
Professor of History and Economics; in charge of Department of Languages, History and Economics; Secretary of the Faculty.

Herbert James Ball, S.B., B.C.S., 119 Wentworth Avenue.
Professor of Textile Engineering; in charge of Department of Textile Engineering and Accountancy.

Gilbert Roscoe Merrill, B.T.E., 364 Varnum Avenue.
Assistant Professor of Textiles: in charge of Department of Cotton Yarns and Knitting.

Stewart Mackay, North Chelmsford.
Assistant Professor of Textile Design.

John Charles Lowe, 161 Dracut Street.
Assistant Professor of Textiles.

Martin John Hoellrich, 30 Saxonia Avenue, Lawrence.
Assistant Professor of Weaving.

Elmer Edward Fickett, B.S., 162 Hovey Street.
Assistant Professor of Analytical Chemistry.

Frederick Steere Beattie, Ph.B., 17 Osgood Street.
Assistant Professor of Organic Chemistry.

Philip Osborne Yeaton, B.S., S.B., 112 Mount Washington Street.
Assistant Professor of Mechanical Engineering.

Harold Canning Chapin, Ph.D., 290 Pine Street.
Assistant Professor of General Chemistry.

Charles Lincoln Howarth, B.T.C., North Billerica.
Assistant Professor of Dyeing.

Percy Charles Judd, B.S., 272 Merrimack Street.
Assistant Professor Electrical Engineering.

Harry Chamberlain Brown, S.B., 272 Merrimack Street.
Assistant Professor of Physics and Mathematics.

James Guthrie Dow, A.B., 11 Robbins Street.
Assistant Professor of Languages.

Cornelius Leonard Glen, 110 Mount Washington Street.
Assistant Professor of Finishing.

Charles Harrison Jack, R.F.D. No. 3, Nashua, N. H.
Instructor in Machine Shop Practice.

Arthur Kimball Johnson, S.B., 841 Moody Street.
Instructor in Chemistry.

Hartman Frank Schmidt, 68 Oakland Street.
Instructor in Wool Yarns.

Albert Greaves Sugden, 13 D Street.
Instructor in Weaving.

Emma Elizabeth Whitney, 156 White Street.
Instructor in Design and Decorative Art.

Arthur Joseph Woodbury, 41 Morey Street.
Instructor in Cotton Yarns.

Ai Edwin Wells, B.T.E., 204 Franklin Street, Melrose Highlands.
Instructor in Electrical Engineering.

Russell Metcalf Fox, 359 Beacon Street.
Instructor in Textile Design.

Charles Arthur Everett, B.T.C., 38 Riverside Street.
Instructor in Dyeing.

Harold Winfred Stiegler, B.T.C., M.S., Ph.D. 535 Lawrence Street, Lawrence.
Instructor in Chemistry.
Lester Whiting Ball, B.S., R.F.D. No. 2, Chelmsford.
Instructor in Mechanical Drawing.
James Harrington Kennedy, Jr., 37 Roberts Street.
Instructor in Wool Yarns and Sorting.
Nathaniel Erskine Jones, 6 Wedge Street.
Instructor in Cotton Yarns.
William George Chace, Ph.B., 123 Westford Street.
Instructor in Mathematics.
John Maurice McArthur, 32 New York Street.
Assistant Instructor in Machine Shop Practice.
Elmer Percy Trevors, 241 Hildreth Street.
Assistant Instructor in Chemistry.
Samuel Meeker, 295 Foster Street.
Assistant Instructor in Chemistry.
Joseph Adrien Lussier, 723 Merrimack Street.
Assistant Instructor in Wool Yarns.
Robert Wilson Parkin, 20 Hurd Street.
Assistant Instructor in Mechanical Drawing.
Clifford Albert Farley, 215 Princeton Street.
Assistant Instructor in Cotton Yarns.
Stephen Kenneth Ford, 66 South Prospect Street, Haverhill.
Assistant Instructor in Chemistry.
Frederick Leo Kenney, 115 Mount Vernon Street.
Assistant Instructor in Weaving.
Walter Ballard Holt, 18 Mount Vernon Street.
Bursar.
Ruth Foote, A.B., S.B., Kimball Street, Nashua, N. H.
Registrar.
Florence Moore Lancey, 46 Victoria Street.
Librarian.
Helen Gray Flack, S.B., 445 Stevens Street.
Secretary.
Gladys Pearl Braden, 77 Woodward Avenue.
Clerk.
Mona Blanche Palmer, 685 Westford Street.
Clerk.

THE LOWELL TEXTILE SCHOOL.

History. — The Lowell Textile School was established by the Trustees of the Lowell Textile School of Lowell, Massachusetts, incorporated in accordance with chapter 475, Acts of 1895. The movement for the establishment of the school dates from June 1, 1891, but it was not opened for instruction until February 1, 1897.

In accordance with the acts of incorporation the Board of Trustees consisted of twenty permanent and self-perpetuating members, three-fourths of whom must be "actively engaged in, or connected with, textile or kindred manufactures." In addition, His Honor the Lieutentant-Governor, the Commissioner of Education of the State, the mayor, the president of the municipal council, the superintendent of schools of Lowell, and a representative of the textile council were members *ex officio*. Legislative acts of 1905 and 1906 authorized the graduates of the school to elect four trustees serving for periods of four years each.

By virtue of the anti-aid amendment to the State Constitution, and by chapter 274, General Acts of 1918, the property of the school was transferred on July 1, 1918, to the Commonwealth of Massachusetts, and the control and management of the school was vested in a Board of Trustees appointed by the Governor, "with all the powers, rights and privileges and subject to all the duties" of the original Board.

In locating the school at Lowell, which has been called the "Mother Textile City of America," considerable advantage is secured by close association with every branch of the industry, which utilizes almost every commercial fiber in the products of the great Merrimack Valley textile district.

Although the school was formally opened by Governor Roger Wolcott on January 30, 1897, in rented quarters in the heart of the city, it was not until January, 1903, that the first buildings of the present plant were ready for occupancy. On February 12, 1903, Governor John L. Bates dedicated the present buildings.

Object. — The object of the establishment of the school as set forth in the original act was "for the purpose of instruction in the theory and practical art of textile and kindred branches of industry."

The plan was occasioned by the apparent crisis in the leading industry of New England, due to the rapid development of the manufacture of the coarser cotton fabrics in the southern States. It was believed that this crisis could be met only by a wider and more thorough application of the sciences and arts in the production of finer and more varied fabrics.

Following the general methods and systems found successful at the higher polytechnic institutes, it offers thorough instruction in principles of the sciences and arts applicable to textile and kindred branches of industry. The courses treat not only of the theory but also the application of these principles in the processes, on the machines and throughout all departments of industry involved in the successful manufacture, application and distribution of textile material in any form.

Because of the breadth, grade and character of instruction given, and because of the standing and personnel of the instructing staff, the school has been placed by both Federal and State educational boards in the class of the higher technological schools of this country.

Though from the first the management has kept in view the clearly defined objective which called for the establishment of the school, to meet the needs of the textile and kindred industries, it has developed its curriculum, its methods of instruction, and equipment as those needs arose. This objective will be kept constantly in view, and as new demands are presented an effort will be made to extend courses, equipment and floor space. The mechanical equipment of the school includes the best makes of textile machinery, and these machines, while built as they would be for regular work, are, as far as possible, adapted to the experimental work which is of particular value in such an institution as this. There is a more varied equipment in this school than in any other, either in America or Europe, and it is now possible to convert the raw stock into the finished fabric within the school.

The day classes have been organized for those who can devote their entire time for three or more years to the instruction requisite in preparing to enter the textile

industries. It has been found necessary to require of all such students educational qualifications equivalent to those given by a regular four-year course of a high school or academy of good standing.

The evening classes are held for about twenty weeks of the year, and are for those who are unable to attend the day courses. These are similar to the day courses, but are aimed especially to meet the needs of students working during the day in the mills and shops. For entrance to these classes an applicant should have the equivalent of a grammar school education. A detailed description of these courses and requirements is given in another Bulletin, which will be sent upon request.

The trustees and faculty of the school confer the degrees of Bachelor of Textile Engineering (B.T.E.) and Bachelor of Textile Chemistry (B.T.C.) upon those students who satisfactorily complete one of the prescribed four-year courses. A diploma is awarded to those who satisfactorily complete one of the three-year courses.

DAY CLASSES.

ENTRANCE REQUIREMENTS.

Degree Courses.

Candidates for admission to either of the degree courses must be graduates of a school approved by the New England College Entrance Certificate Board or by the Board of Regents of New York, and must present a certificate from the principal of the school last attended, reporting upon the subjects pursued and the points obtained according to the schedule of studies given hereafter. A total of fourteen points is required.

A point represents satisfactory work in a year's study in a specified subject in an approved secondary school.

Required Subjects.	Points.
Algebra A1	1
Algebra A2	1
English	4
Elementary French A (two years) or Elementary German A (two years)	2
Plane Geometry	1
History (American, Mediæval and Modern, or English)	1
Physics	1
	11

Elective Subjects.	
Chemistry	1
English	1
Elementary French (two years) or Elementary German (two years)	2
Advanced French or German (one year in addition to requirements of Elementary French A or Elementary German A)	1
History:	
American	1
Mediæval and Modern	1
English	1
Latin	1
Mechanical Drawing	1
Mechanic Arts	1
Solid Geometry	1
Spanish	1
Trigonometry	1

An applicant may also be admitted on the basis of entrance examinations in which case he must pass a sufficient number of the required subjects to make ten points, and present certificates showing satisfactory courses in such of the elective subjects to make three additional points.

The objective of the elective requirements is to encourage greater breadth of preparation than that covered by the required branches. Certificates covering other subjects than those listed as elective will be entertained.

Diploma Courses.

Candidates for admission to the diploma courses are accepted upon presentation of properly vouched certificates showing the completion of a regular four-year course in a high school or academy of reputable standing. The certificate must specify that the applicant has satisfactorily passed the required subjects.

A total of twelve points is required.

Required Subjects.	Points.
Algebra A1	1
Algebra A2	1
English	4
Plane Geometry	1
History (American, Mediæval and Modern, or English)	1
Physics	1
	9

Elective Subjects.

Three may be selected from the list under Degree Courses.

ENTRANCE EXAMINATIONS.

All students who are unable to present a certificate for either the degree or the diploma courses must pass entrance examinations. Notification of intention to take these examinations must be made in writing at least a week before the date of the examinations. These will be held as follows: —

Thursday, June 9, 1927; Thursday, September 15, 1927; Thursday, June 7, 1928: —
- Algebra, 9 A.M. to 11 A.M.
- History, 11 A.M. to 1 P.M.
- English, 2 P.M. to 4 P.M.

Friday, June 10, 1927; Friday, September 16, 1927; Friday, June 8, 1928: —
- Plane Geometry, 9 A.M. to 11 A.M.
- German or French, 11 A.M. to 1 P.M.
- Physics, 2 P.M. to 4 P.M.

Candidates failing to pass the June examinations are allowed to try again in September; those who cannot attend the June examinations may present themselves in September.

REQUIRED SUBJECTS FOR ENTRANCE.

Algebra A1. — Fundamental operations, factoring, determination of the highest common factor and least common multiple, fractions, simple and complex, simple equations of one or more unknown quantities, problems involving linear equations of either numerical or literal quantities, radicals, involution and evolution, square and cube root, ratio and proportion, exponents including fractional and negative.

Algebra A2. — Quadratic equations both numerical and literal. Simple problems involving one or more unknown quantities that may be solved by the methods of linear or quadratic equations, binomial theorem for positive integral exponents, problems involving methods of arithmetical and geometrical progressions.

Plane Geometry. — The usual theorems and constructions of good textbooks, including the general properties of plane rectilinear figures, the circle and the measurement of angles, similar polygons, areas, regular polygons, and the measurement of the circle. The solution of original problems and problems in mensuration of lines and plane surfaces.

English. — As secondary schools are following to a greater extent than heretofore the requirements of the College Entrance Examination Board, it is recommended that the applicant to this school conform to the suggestions of this Board relative to English composition and literature.

The examination consists of two parts, both of which are given at the same time.

(*a*) With the object of testing the student's ability to express his thoughts in writing clearly and correctly he will be required to write upon subjects familiar to him. Emphasis will be laid upon the composition, punctuation, grammar, idiom and formation of paragraphs. He will be judged by how well he writes rather than by how much he writes.

(*b*) The second part of the examination is prepared with the view of ascertaining the extent of the student's knowledge of good literature, and to test this examination questions will be based on the books adopted by the National Conference on Uniform Entrance Requirements. Any course of equivalent amount if made up of standard works will be accepted.

Modern Languages.

Requirements for Degree Courses.

It is expected that the work in these subjects has covered a period of at least two years of preparatory school training or the equivalent. Importance should be given to the ability to translate into good idiomatic English, but attention should also be paid to grammar and construction, that greater care may be used in translation.

Elementary German A. — The entrance examination is composed of two parts, both taken, however, at the same time.

(*a*) Translation of simple German prose into good idiomatic English.

(*b*) Questions to test proficiency in grammar, and simple English sentences to be rendered into German.

The requirements include the declension of articles, adjectives, pronouns and nouns; the conjugation and inflection of weak and strong verbs; the simpler uses of the subjunctive; the use of the modal auxiliaries; the prepositions and their uses; the principal parts of important verbs; and the elementary rules of syntax and word order.

Texts used in the language courses of any reputable high or preparatory school will furnish reading for translation. A list of texts is offered by the College Entrance Examination Board.

Elementary French A. — The entrance examination is composed of two parts, both taken, however, at the same time.

(*a*) Translation of simple French prose into good idiomatic English.

(*b*) Questions to test proficiency in grammar, and simple English sentences to be rendered into French.

The requirements include the principal parts, conjugation and inflection of the regular and the more common irregular verbs; the singular and plural forms of nouns and adjectives; the uses of articles and partitive construction; the forms and positions of personal pronouns; and the simpler uses of the conditional and subjunctive.

Suitable texts are suggested by the language courses of any reputable high or preparatory school and by the requirements of the College Entrance Examination Board.

Students who have pursued two years of elementary French as well as two years of elementary German may present one subject to cover two points in the required subjects, and the other to cover two points in the elective subjects.

History.

Applicants may offer a preparation of American history, English history or mediæval and modern history.

In American history applicants should be familiar with the early settlements in America, the colonies, their government, the customs of the people, and events which led to the establishment of the United States. They should be informed concerning the causes and effects of the principal wars in which the country has been involved. They should be prepared to consider also questions requiring an elementary knowledge of civil government, as well as historical facts connected with the growth of this country up to the present time.

For the subject of English history or mediæval and modern history the course given in any reputable secondary school should give proper preparation. A course extending over a full year with not less than three periods a week will be accepted.

Physics.

The applicant should be familiar with the fundamental principles of physics, particularly those considered under the headings of mechanics, heat, light, electricity and magnetism. Textbook instructions should be supplemented by lecture table experiments. Wherever possible, the student should pursue a laboratory course, but for the present no applicant will be conditioned in this subject if he has not been able to carry on a laboratory course. Where a laboratory course is offered by a secondary school, it should cover at least twenty-five of those experiments listed in the syllabus of the College Entrance Examination Board. An applicant should present his notebook, together with the certificate from the teacher under whom the work was performed.

ELECTIVE SUBJECTS.

History. — If the applicant can present all three or any two branches of history specified he may include one as a required subject and the others in the list of elective subjects.

Chemistry. — Applicants must show evidence of their familiarity with the rudiments of chemistry. Any course given in a secondary school organized to

present instruction by means of textbook or lecture, together with correlated laboratory work, will be considered as covering the requirements. The applicant's notebook with his original notes, including description of experiment, apparatus used, reactions, observations and deductions, must be accompanied by his instructor's certificate.

Importance will be placed upon manipulation and deductions as well as the general appearance and neatness of the notebook.

Solid Geometry. — The usual theorems and constructions of good textbooks, including the relations of planes and lines in space, the properties and measurement of prisms, pyramids, cylinders and cones; the sphere and spherical triangles. The solution of original problems and the applications of the mensuration of surfaces and solids.

Trigonometry. — The usual courses of instruction covered by the standard textbooks on plane and spherical trigonometry will prepare an applicant sufficiently to meet this requirement.

Mechanical Drawing. — The applicant must have pursued such a course in mechanical drawing that he will be familiar with the usual geometrical construction problems, projection of points, lines, planes and simple solids.

Importance is laid not only upon the accuracy with which the work is performed, but upon the general arrangement, appearance and care with which the plates are executed.

It should not be understood that work in this subject may be offered as the equivalent of the first term's work at the school.

Mechanic Arts. — The usual courses offered by properly equipped preparatory schools will be accepted as suitable fulfillment of this requirement. Work should include instruction in the handling of both wood and metal working tools in the more simple practices of these arts.

Elementary French B. — Applicants who enter for one of the three-year courses may present one year's work in French in a secondary school. Those who present themselves for examination in this subject should be familiar with the rudiments of grammar, and be able to translate simple French prose into good idiomatic English, also to translate into French English sentences, based on the French given for translation.

Elementary German B. — Applicants who enter for one of the three-year courses may present one year's work in German in a secondary school. What is stated in regard to French applies to those who may present German instead of French.

Advanced French or German. — In cases where applicants have pursued courses in French or German for more than two years, and have completed work which is more advanced than is included under elementary French or German, they may offer the additional year as an elective.

Spanish. — Students offering Spanish should be familiar with elementary grammar, the common irregular verbs, and be able to translate simple Spanish to English or English to Spanish. A preparation equivalent to three periods per week for two years will be acceptable.

Latin. — Students who have pursued one or more years of Latin may present this subject as an elective. Each year's work satisfactorily completed will be considered equal to one point.

GENERAL INFORMATION.

Preparation. — Particular stress should be laid upon a thorough grounding in mathematics, including algebra, arithmetic and plane geometry, as these form the basis upon which the work of this school rests. While solid geometry is not required at the present time, the student will find a knowledge of this subject very valuable in his subsequent work, and is strongly recommended to include this subject as one of his electives. A preliminary course in science, including physics, and chemistry, serves to prepare the student's mind for the higher branches of these subjects and their application, but neither will be considered as the equivalent of the courses in these branches given in the school.

Advanced Standing. — Candidates who may have received previous training in any of the subjects scheduled in the regular course will, upon presentation of acceptable certificates, be given credit for such work.

Registration. — All students are required to register on or before the Monday of the week beginning the school year, and again during the midyear examination period. For unexcused delay in registration a fee of $5 will be imposed.

Application Blanks. — A blank form of application for admission may be found at the end of this bulletin. This should be properly filled out by all applicants, whether entering upon certificate from a secondary school or presenting themselves for examination.

Fees. — The fee for the day course is $150 per year for residents of Massachusetts. For non-residents the fee for all courses is $200 per year. The fee for students from foreign countries is $300 per year.

Three-fifths of the fee is charged for a single term. Each term's tuition is payable during the first week of that term. Students failing to make this payment at the specified time will be excused from classes until satisfactory explanation and arrangements for payment can be made. *No bills will be sent.* After payment is made no fee or part thereof can be returned, except by special action of the trustees.

An athletic fee of $15 is due and payable at the time of the first payment of tuition.

Special students pay, in general, the full fee, but if a course be taken involving attendance at the school during a limited time, application may be made to the president for a reduction.

Students must provide their own books, stationery, tools, etc., and pay for any breakage or damage that they cause. The above fee includes free admission for any day students desiring to attend any of the evening classes in which there is accommodation.

For all first-year students a minimum deposit of $25 is required to cover the cost of breakage, supplies, and apparatus and chemicals used in the Chemical Laboratory, the unexpended balance to be returned to the student at the end of the year.

For all students in second, third and fourth years taking work in Chemistry and Dyeing Laboratories a deposit of $25 for the first term and $25 for the second term is required. Students taking Machine Shop will be required to make deposit of $15 to cover cost of materials, supplies and breakage. Included in this charge is a kit of tools which is essential to the work and which becomes the personal property of the student. The unexpended balance will be returned at the end of the year.

Students not taking Chemistry Laboratory or Machine Shop will be required to make a deposit of $10 each year to cover general breakage. The unexpended balance will be returned at the end of the year.

All deposits must be made before students can be admitted for laboratory work.

Examinations. — For first-year students intermediate examinations are held every five weeks, and these serve to inform the student concerning his standing and the progress made.

For students in upper classes informal examinations will be held during the eighth week of each term.

Formal examinations are held at the end of each term.

In general, the examinations cover the work of the preceding term, but at the discretion of the instructor may include work of earlier terms.

Examinations for students conditioned in first-term subjects are held during the second term, and examinations for students conditioned in the second-term subjects are held in September following. Students requesting condition examinations at other than scheduled dates will be required to pay $5 for each examination so taken.

Any student who fails to complete a subject satisfactorily or to clear a condition at the time appointed, will be required to repeat the subject, and he cannot be admitted to subjects dependent thereon.

A student whose term's standing is as a whole so low that he cannot continue with profit the work of the next term will be required to leave school, but he may return the following year to repeat such subjects as are required.

Daily work and regularity of attendance are considered in making up the reports of standing.

Continued or persistent absence or tardiness from the classes is considered reason to exclude a student from the class.

Records and Reports of Standing. — During each term informal reports are sent to parents or guardians of all students under age, and to all students; and at the end of each term formal reports are made.

The daily work of the student forms an important part of his record, and no pupil will be awarded the diploma or degree unless this portion of his record is clear.

Books are prescribed for study, for entry of lecture notes and other exercises, and are periodically examined by the lecturers. The care and accuracy with which these books are kept are considered in determining standing.

Attendance. — Attendance is required of all students on fourteen-fifteenths of all scheduled class exercises, provided they meet the requirements of their instructors for the omitted exercises. For every unexcused absence from any class exercise in excess of those allowed, a deduction from the mark obtained in the course in which the absences occurred will be made.

Advisers. — Advisers are appointed for all students, to be of such aid and assistance as they can both inside and outside of school hours. The head of the department in which a student is registered is adviser to upper-classmen, and instructors in charge of freshman classes act as advisers to freshmen.

Thesis. — Each candidate for the degree of the school must file with the head of the department in which the thesis is taken, and not later than May 15, a report of original investigation or research, written on a good quality of paper, 8½ by 11 inches, with 1-inch margin at left, and one-half inch at right, of each page; such thesis to have been previously approved by the head of the department in which it is made.

For all candidates for the diploma this requirement will be optional on the part of the school.

Graduate Course. — Graduates of technical courses of other schools are invited to communicate with the president with reference to special courses in the textile studies. Previous training in the sciences and the engineering branches will usually reduce materially the time necessary to complete any of the courses at this school. The advantages offered to such persons for special research work are unexcelled, and a most profitable course may be arranged.

Degrees. — The degree of Bachelor of Textile Engineering will be awarded for the completion of the four-year course in textile engineering. The degree of Bachelor of Textile Chemistry will be awarded for the completion of the four-year course in chemistry and textile coloring.

Diploma. — For the present the diploma of the school will be awarded upon the satisfactory completion of any one of the regular three-year courses. In cases where students obtain advanced standing, at least one year's attendance is required before the diploma can be obtained.

Conduct. — Students are required to return to the proper place all instruments or apparatus used in experimental work, and to leave clean and in working order all machinery and apparatus with which they may experiment. All breakages, accidents or irregularities of any kind must be reported immediately to the head of the department or instructor in charge.

In case of either day or evening students, irregular attendance, lack of punctuality, neglect of either school or home work, disorderly or ungentlemanly con-

duct or general insubordination are considered good and sufficient reasons for the immediate suspension of a student, and a report to the trustees for such action as they deem necessary to take.

It is the aim of the trustees so to administer the discipline of the school as to maintain a high standard of integrity and a scrupulous regard for trust. The attempt of any student to present, as his own, work which he has not performed, or to pass any examination by improper means, is regarded by the trustees as a most serious offence, and renders the offender liable to immediate suspension or expulsion. The aiding or abetting of a student in any dishonesty is also held to be a grave breach of discipline.

Any student who violates these provisions will be immediately suspended by the president, and the case reported at the following meeting of the trustees for action.

Library and Reading Room. — That the students may have surroundings conducive to reading and study a moderate-sized reading room with library tables and chairs has been provided. The library shelves contain textile, art, engineering and scientific publications. These are increased from time to time as new technical books of value to textile students are issued from the press. The leading textile papers are kept on file for ready reference.

Sessions. — The regular school sessions are in general from 9.00 A.M., to 12.50 P.M., and from 1.55 to 4.30 P.M., except Saturdays, when there is no session of the school. On Saturday afternoons the buildings are closed.

An hour plan designates the hours at which the various classes meet. This is rigidly adhered to, and the student is marked for his attendance and work as therein scheduled.

Residence and Expenses. — Students from a distance, requiring rooms and board in the city, may, if they desire, select the same from a list which is kept at the school. The cost of rooms and board in a good district is $12 per week and upwards.

All raw stock and yarn provided by the school, and all the productions of the school, remain, or become, the property of the school, except by special arrangement; but each student is allowed to retain specimens of yarn or fabrics that he has produced, if mounted and tabulated in accordance with the requirements of the school. It is understood that the school may retain such specimens of students' work as they may determine.

Lockers are provided for the use of the students, sufficiently capacious to contain clothing, books and tools.

No books, instruments or other property of the school are loaned to the students to be removed from the premises except by special permission.

Scholarships. — The Massachusetts Charitable Mechanic Association has offered six scholarships of $250 each which are for the purpose of defraying school expenses of such students as may be selected by a committee composed of a representative from the Association, one from the Board of Trustees and the President of the School.

Herbert A. Currier of the class of 1906 has offered a prize of $100 to a student who may be selected by the faculty of the school, and in making the selection the following conditions will be considered: scholastic standing, financial need, and ability in promoting student activities in school life. The scholarship will be awarded to a member of the sophomore, junior or senior class.

Medals of Honor. — The National Association of Cotton Manufacturers offers annually a medal to that member of the graduating class who shall have during his course attained the highest standing in the special subjects required by the vote of the association.

Special Awards of Merit. Louis A. Olney Book Prize.

Prizes in the form of books are awarded each year to the successful candidates on graduation day. The conditions in detail are as follows:—

First. — Ten dollars to the student taking the regular Chemistry and Textile Coloring Course who shall be considered as having attained the highest scholarship in first-year chemistry.

Second. — Five dollars to the student taking the regular Chemistry and Textile Coloring Course, who shall be considered as having attained the second highest scholarship in first-year chemistry.

Thir l. — Ten dollars to the regular student of the Chemistry and Textile Coloring Course who shall be considered as having obtained the highest scholarship during his second year.

Fourth. — Five dollars to the regular student of the Chemistry and Textile Coloring Course who shall be considered as having attained the second highest scholarship during his second year.

Fifth. — Twenty dollars to the regular student in the Chemistry and Textile Coloring Course who shall present the best thesis preparatory to graduation.

The above-mentioned sums are to be invested in books which may be selected after graduation. In case no one is considered worthy of any particular scholarship prize, or if there is no competition, the same may be withheld. The decision in such case shall rest with the judges.

Edward A. Bigelow Prize. — Edward A. Bigelow, class of 1906, has offered the following cash prizes: $100 to the member of the class graduating from the Wool Manufacturing course who maintains the highest standing throughout his three years; $50 to the member of the second year class in the Wool Manufacturing course who maintains the highest standing during his second year; $25 to the member of the first year class in the Wool Manufacturing course who maintains the highest standing during his first year.

Saco-Lowell Prize. — The Saco-Lowell Machine Shop of Lowell, Mass., offers a prize of $100 for the thesis prepared for graduation which will be considered of greatest value to the textile industry. Only candidates for a degree are eligible for this prize and the selection is to be made by a board comprised of three members, one from the Saco-Lowell Shops, one from the National Association of Cotton Manufacturers and one from the Lowell Textile School.

Textile Colorist Award. — The Textile Colorist, Inc., has offered a prize of $100 to be awarded to a member of the graduating class whose thesis, based upon his personal researches and experiences, is of the greatest practical value to the dyeing, bleaching or textile finishing industries.

Awards. — Gold medal, Paris Exposition, 1900, for general excellence. A special medal, Merchants and Manufacturers Exposition, Boston, 1900. The Pan-American medal, awarded to the school, 1901. Gold medal, Louisiana Purchase Exposition, 1904. Gold medal, Lewis and Clark Centennial Exposition, 1905. Medal of honor from Panama-Pacific International Exposition, 1915.

Bulletins and Catalogues. — All students registering and paying the regular fee for the course selected are entitled to the bulletins and catalogues when issued.

Orientation Week. — A program which is planned to acquaint the new student with the institution, its location and surroundings, its courses of instruction, its recreational activities and other phases of its life has been planned for the opening week. Unless arrangements for room and board have been made previously, the first two days of the week may be used for this purpose. Each freshman is expected to be in daily attendance beginning Wednesday, September 21, at 9.00 A.M. and to follow the prepared program which will be placed in his hands. Physical examinations as well as certain other tests will be given during this orientation period. Freshman week enables the student to secure the advantages which come from acquaintance with his surroundings, his instructors, the members of his class, student organizations, activities and customs. The overcrowding of the first week of classes with distractions is thus avoided.

COURSES OF INSTRUCTION.

Since its establishment the Lowell Textile School has offered courses, each of which extends over a three-year period. With the development of the school and close study of the problems presented to the graduates it has been found that attention should be given those branches of instruction which would give breadth of training as well as establish fundamental principles. This policy has resulted in extending the curriculum to such length that the need for an additional year's instruction was evident.

The fact was also appreciated that to carry on the more advanced work a better preparation must be demanded of the applicant for entrance.

Nevertheless, it was recognized that many young men seeking employment in the textile industry do not care, or are not in a position, to devote four years to scholastic preparation, and for these the regular three-year courses are offered.

These courses are designated as Cotton Manufacturing, Wool Manufacturing and Textile Design (General Textile Courses), upon completion of any one of which the regular diploma of the school is awarded.

In general, it is assumed that students pursuing these courses will not take the advanced work of the fourth year. However, if a student electing one of the three-year courses desires to change to one of the four-year courses he may do so providing his preparation and undergraduate standing permit it.

The four-year courses are Textile Engineering, Chemistry and Textile Coloring. At the completion of these courses the degrees of Bachelor of Textile Engineering (B.T.E.) and Bachelor of Textile Chemistry (B.T.C.) are conferred.

Three options are offered in the Engineering Course, viz., general textile, cotton manufacturing or wool manufacturing. Each of these courses is planned to train one in the fundamental principles of science found to be applicable in the particular fields of textile chemistry and textile engineering. It is maintained that for one to be successful in either of these important branches of industry a training is required as thorough and broad as that of any of the recognized branches of engineering or of applied science.

With this in mind these courses have been built of a secure framework of science and mathematics, and to it has been added the useful application of these branches in the broad textile field. With the direct purpose of laying a secure foundation in the training, a more extended preparatory course is first demanded, and subsequently in the school work more subjects of a general character are included, that narrowness of judgment and observation may not result by overstimulation of the technical development.

COURSES FOR WOMEN.

Although all classes are open to women, the courses which have appealed especially to their tastes have been textile designing and decorative art. Some have pursued courses in chemistry, and have added to their work in design some instruction in power weaving and finishing. These special courses have in general been followed for three years, and in some cases have led the students to positions either in the mill office or in some commercial lines that have been desirable and have offered congenial work.

Within the last few years the possibilities for women in certain branches of textile chemistry have become recognized, and it is believed that in the future the positions open to them will become more and more numerous.

GOVERNMENT POSITIONS.

One of the significant and important facts that has been clearly demonstrated during the recent conflict is the great value of a technical education. In no war has the applied science been so forcefully used as a weapon of combat.

An earlier catalogue pointed out the calls that the various departments of the government were making for graduates from this school in common with those of other technological institutions. The success attained by past students has been presented in a previous bulletin. As these men have shown their value to the government in times of war, so will they in times of peace. Before the war

various departments of the government had found need for graduates from this textile school, and with the problems of peace the need undoubtedly will become greater.

The United States Civil Service Commission recognizes graduates from the degree courses of this school as proper applicants for the examination to the various positions requiring a knowledge of applied science and engineering, as well as a knowledge of textile manufacturing, in the different departments of the government.

COURSES.

In the column headed "Hours of Exercise" the numbers represent for each particular subject the total hours required in school for a period of fifteen weeks.

The letter and number which follow the subjects indicate the department in which the subject is given and the number of the subject in that department. For detailed description of the same, see page 30.

The departments are indicated as follows:—

Textile Engineering	B	Cotton Yarns	F
Chemistry and Dyeing . . .	C	Woolen and Worsted Yarns . .	G
Textile Design and Power Weaving,	D	Finishing	H
Languages and History . . .	E		

By referring to the letter and number indicated under "Preparation" the student can ascertain what subjects are necessary in order that he may have a clear understanding of the subject which he is scheduled to take.

First Year.

First Term.

[Common to all courses.]

	Hours of Exercise.
Mechanics B–11	60
Mechanical Drawing B–14	90
Mathematics B–10	45
Textile Design and Cloth Analysis D-10	90
Elementary Chemistry C–10	165
English E–10	45
Physical Education	30

Second Term.

	Course IV	Course VI
Mechanism B–12	60	60
Machine Drawing B–15 and B–15a	30	90
Mechanical Laboratory B–13	–	30
Mathematics B–10	45	45
Textile Design and Cloth Analysis D–10	–	60
Elementary Chemistry C–10	75	75
Technology of Fibers F–10, G–10 and C–11	60	60
English E–10	45	45
Elementary German E–11 or Elementary French E–12	30	30
Qualitative Analysis C–12	135	–
Stoichiometry C–13	15	–
Physical Education	30	30

For second-term subjects in Courses I, II and III, see pages 19, 21, 23.

Cotton Yarn Department

Course I. — Cotton Manufacture.

The Cotton Manufacturing Course is designed for students contemplating a career in the manufacturing of cotton yarns and cloth or allied industries, and wishing to devote but three years to the school work.

During the first term the studies are common to all courses, and include instruction in mechanism, mathematics, mechanical drawing, textile design and elementary chemistry. Laboratory work supplements the lectures in chemistry, and weaving assists in illustrating the principles of textile design. At the commencement of the second term instruction in the preliminary processes of yarn manufacturing is given in the course of technology of fibers.

The work in the Cotton Yarn Department comprises instruction in all the manufacturing processes from the bale to the finished yarn. The instruction is given by means of lectures upon the machines and processes, and by laboratory work upon the machines themselves. In the laboratory each student is required to make exhaustive tests upon each machine, and to make as many settings and adjustments as possible. The third year's work in this department is largely devoted to lectures upon the manufacture of specialties, waste products, etc., and special laboratory work, special tests upon yarns and fabrics, mill planning with regard to the arrangement of machinery, and other work of an advanced nature.

The course in chemistry consists of lecture and laboratory work on inorganic and organic chemistry, followed by a lecture course of instruction in textile chemistry and dyeing.

The work in mechanism serves as a basis for all future machine and mechanical work, and is followed by steam engineering, electricity and mill engineering. The mechanical drawing taken in connection with these subjects augments this instruction as well as provides opportunity for students to become skilled in drafting.

The course in textile designing, cloth analysis and cloth construction includes lectures on plain and fancy weaves and Jacquard work, the analysis of all commercial fabrics, and designs for the same. During the third year of this course students in this department specialize on cotton fabrics.

Power weaving is taken up during the second and third years. Commencing with lectures and practice upon plain looms, the student is taken through dobby and box-loom weaving and Jacquards.

A course in knitting taken during the third year includes the manufacture of hosiery and underwear. The course on the finishing of cotton fabrics is given by lectures and laboratory work, and requires considerable work on standard machines in the laboratory.

For detailed description of the subjects see page 30.

Course I. — Cotton Manufacture.

[For first term see page 16.]

FIRST YEAR. SECOND TERM. (HOURS OF EXERCISE.)

Mechanism B–12	60	Technology of Fibers F–10, G–10, C–11	60
Machine Drawing B–15	75	Elementary Chemistry C–10	75
Mathematics B–10	45	English E–10	45
Textile Design and Cloth Analysis D–10	135	Physical Education	30

SECOND YEAR. FIRST TERM.

Cotton Yarn Mfg. F–20	195	Machine Drawing B–21	30
Textile Design and Cloth Analysis D–20	75	Steam Engineering B–24	45
Power Weaving D–22	90	Physics B–22	45
Chemistry and Dyeing Lect. C–21	30	Industrial History E–22	15

SECOND YEAR. SECOND TERM.

Cotton Yarn Mfg. F–20	210	Steam Engineering B–25a	15
Textile Design and Cloth Analysis D–20	60	Machine Drawing B–21	45
Power Weaving D–22	120	Physics B–22	45
Chemistry and Dyeing Lect. C–21	15	Industrial History E–22	15

THIRD YEAR. FIRST TERM.

Cotton Yarn Mfg. F–30	195	Cotton Finishing H–31	75
Knitting F–31	60	Electricity B–34a	30
Textile Testing G–31	15	Mill Engineering B–35a	30
Power Weaving D–31	120		

THIRD YEAR. SECOND TERM.

Cotton Yarn Mfg. F–30	240	Cotton Finishing H–31	75
Knitting F–31	60	Textile Testing G–31	15
Power Weaving D–31	135	Thesis.	

Course II. — Wool Manufacture.

The course on wool manufacturing is arranged for those who contemplate a career in the manufacture of woolen or worsted fabrics, and can devote but three years to the school work. It includes instruction on all of the varied processes employed in manipulating the wool fiber to produce yarn and cloth, namely, sorting, scouring, carding, combing, spinning, designing, weaving, dyeing and finishing. The work is carried on by lectures, recitations and practical work in the laboratories.

Following the first term of the first year, which is common to all courses, the student taking technology of fibers becomes acquainted not only with the various kinds of wool and trade terms applied to them, but also with other commercial fibers, viz., cotton silk, jute, hemp, flax, etc., used in the textile industry. He is at the same time taught the application of these fibers and the general processes of manufacturing each into a yarn.

Beginning with the second year the details of manipulating wool from the grease to the finished yarn is taken up for close study. This includes the spinning of woolen yarn, also worsted yarn, by both the English and the French systems. The intermediate processes of sorting, scouring, carding, combing and top-manufacturing are taken in detail and in proper sequence.

The general chemistry of the first year is followed by a lecture course in the second year on textile chemistry and dyeing.

Textile design, cloth analysis and construction are continued from the first year throughout the course, the work being applied especially to woolen and worsted goods. Weaving on power looms commences in the second year and continues through the third.

Lectures on finishing commence with the third year and are augmented by extensive practice with the machines in the Finishing Department.

Work in the Engineering Department extends throughout all three years, and includes mechanical drawing, steam engineering and electricity. The practical application of the principles studied in these subjects is brought out forcibly in the work on mill engineering, where mill design and construction are considered. A short course covering methods employed in the testing of fibers, yarns and cloths, together with laboratory work in the manipulation of certain physical apparatus, is given in the third year.

For detailed description of the subjects see page 30.

Course II. — Wool Manufacture.

[For first term see page 16.]

First Year. Second Term. (Hours of Exercise.)

Mechanism B–12	60	Technology of Fibers G–10, F–10, C–11	60
Machine Drawing B–15	75	Elementary Chemistry C–10	75
Mathematics B–10	45	English E–10	45
Textile Design and Cloth Analysis D–10	135	Physical Education	30

Second Year. First Term.

Top Manufacture G–20	210	Machine Drawing B–21	30
Textile Design and Cloth Analysis D–21	90	Steam Engineering B–24	45
Power Weaving D–22	60	Physics B–22	45
Chemistry and Dyeing Lect. C–21	30	Industrial History E–22	15

Second Year. Second Term.

Top Manufacture G–20	255	Steam Engineering B–25a	15
Textile Design and Cloth Analysis D–21	60	Machine Drawing B–21	45
Power Weaving D–22	75	Physics B–22	45
Chemistry and Dyeing Lect. C–21	15	Industrial History E–22	15

Third Year. First Term.

Yarn Manufacture G–30	195	Electricity B–34a	30
Knitting F–31	60	Mill Engineering B–35a	30
Power Weaving D–31	120	Textile Testing G–31	15
Finishing H–30	75		

Third Year. Second Term.

Yarn Manufacture G–30	255	Power Weaving D–31	120
Knitting F–31	60	Finishing H–30	75
Textile Testing G–31	15	Thesis.	

Course III. — Textile Design.

The general course in textile design is planned to meet the demand of young men for a technical training in the general processes of textile manufacturing, but with particular reference to the design and construction of fabrics. To this end a foundation is laid in the first year by instruction in the elementary principles of designing, decorative art and weaving. That he may later in the course pursue to advantage instruction in yarn manufacturing, weaving, dyeing, finishing and some engineering problems, a foundation course in mechanics, mathematics and chemistry is laid. As the student is required to pursue courses in the yarn departments, both cotton and wool, he acquires a knowledge of the manufacture of cotton yarns from the bale to the yarn, and of woolen and worsted yarns from the fleece through the varied processes of manufacturing woolen yarn or worsted yarn by both the French and Bradford systems.

Throughout his entire course he receives instruction in design, cloth analysis and construction of all the standard cloths, viz., trouserings, coatings, suitings, blankets, velvets, corduroys, plushes, etc. This is followed by advanced work in Jacquard designing and weaving, which serves not only to acquaint the student with the many kinds of cotton, woolen, worsted and silk fabrics of figured design, but stimulates and develops any artistic talent he may possess. Decorative art becomes an important part of the work of the second and third years.

The course in general inorganic and organic chemistry of the first year leads to the subject of textile chemistry and dyeing in the second year.

Power weaving commences with the second year and continues throughout the course, and work on all types of looms is required.

During the third year the student receives instruction in the finishing of cotton goods and woolen and worsted cloths. This instruction is given by means of lecture and laboratory work.

The engineering subjects given in the second and third years are intended to acquaint the student with such general knowledge as will be of assistance should he be called upon in later life to be a mill manager, or should his subsequent progress lead to some executive position in the operation of a textile plant.

For detailed description of the subjects see page 30.

Course III. — Textile Design.

[For first term see page 16.]

FIRST YEAR. SECOND TERM. (HOURS OF EXERCISE.)

Mechanism B–12	60	Tech. of Fibers F–10, G–10 and C–11	60
Machine Drawing B–15	75	Elementary Chemistry C–10	75
Mathematics B–10	45	English E–10	45
Textile Design and Cloth Analysis D–10	135	Physical Education	30

SECOND YEAR. FIRST TERM.

Textile Design and Cloth Analysis D–20, 21	150	Machine Drawing B–21	30
Cotton Yarn Mfg. F–20	150	Steam Engineering B–24	45
Power Weaving D–22	60	Physics B–22	45
Chemistry and Dyeing Lect. C–21	30	Industrial History E–22	15

SECOND YEAR. SECOND TERM.

Textile Design and Cloth Analysis D–20, 21	135	Top Manufacture G–20	105
Cotton Yarn Mfg. F–20	75	Steam Engineering B–25a	15
Power Weaving D–22	75	Physics B–22	45
Chemistry and Dyeing Lect. C–21	15	Industrial History E–22	15
		Machine Drawing B–21	45

THIRD YEAR. FIRST TERM.

Textile Design and Cloth Construction D–30	120	Power Weaving D–31	75
Yarn Manufacture G–30	90	Wool Finishing H–30	75
Mill Engineering B–35a	30	Cotton Finishing H–31	75
Knitting F–31	15	Electricity B–34a	30
		Textile Testing G–31	15

THIRD YEAR. SECOND TERM.

Textile Design and Cloth Construction D–30	180	Wool Finishing H–30	75
Yarn Manufacture G–30	90	Cotton Finishing H–31	75
Knitting F–31	15	Textile Testing G–31	15
Power Weaving D–31	75	Thesis.	

Course IV. — Chemistry and Textile Coloring.

The four-year Course in Chemistry and Textile Coloring, leading to the degree of B.T.C., is especially intended for those who wish to engage in any branch of textile chemistry, textile coloring, bleaching, finishing or the manufacture and sale of the dyestuffs or chemicals used in the textile industry. The theory and practice of all branches of dyeing, printing, bleaching, scouring and finishing are taught by lecture work supplemented by a large amount of experimental laboratory work and actual practice in the dyehouse and finishing room.

The underlying theories and principles of chemistry are the same, no matter to what industry the application is eventually made. Furthermore, no industry involves more advanced and varied applications of the science of chemistry than those of the manufacture and application of the coal-tar coloring matters. In addition, the textile colorist must consider the complex composition of the textile fibers, and the obscure reactions which take place between them and the other materials of the textile industry.

During the first year general chemistry, including both inorganic and organic, is taught by lectures and laboratory work, and this is supplemented during the second term by qualitative analysis and stoichiometry.

Advanced inorganic chemistry, as well as advanced organic chemistry, is studied during the second and third year as a continuation of the elementary chemistry of the first year, and much time is spent upon quantitative analysis, industrial chemistry, and textile chemistry and dyeing.

The foundation work in general chemistry is continued during the third year with courses in physical chemistry, organic laboratory work and analytical work. The subject of industrial chemistry is introduced, and much time is devoted to advanced textile chemistry, dye testing, color matching, calico printing and woolen, worsted and cotton finishing.

The fourth year is characterized by an endeavor to present certain subjects of a more applied nature in such a manner that the student's reasoning power and ability to apply the knowledge gained during the first three years may be developed to the fullest extent. The subject of engineering chemistry is introduced, and the work in the Dyeing and Analytical Laboratories is applied as far as possible to the actual requirements of the factory chemist and colorist. The student is given a thorough course in microscopy, photomicrography and the use of the various instruments, such as the spectroscope, ultra-microscope, polariscope, tintometer, etc., which often prove of vital importance in the advanced study of textile chemistry. During this fourth year the student devotes much time in the Organic Laboratory in the manufacture of dyestuffs. This is followed by some research work or original investigation as time will permit. Upon this he must present a satisfactory thesis, or report, before receiving his degree.

For detailed description of the subjects see page 30.

Course IV. — Chemistry and Textile Coloring.

[For first year see page 16.]

Second Year. First Term. (Hours of Exercise.)

Adv. Inorganic Chemistry C–23	30	Quantitative Analysis C–25	195
Textile Chemistry and Dyeing Lect. C–21	30	Steam Engineering B–24	45
Chemistry and Dyeing Lab. C–22	75	Physics B–22	45
Stoichiometry C–20	15	Industrial History E–22	15
		Advanced German E–21	30
		Mathematics B–20	45

Second Year. Second Term.

Adv. Inorganic Chemistry C–23	30	Quantitative Analysis C–25	150
Chemistry and Dyeing Lect. C–21	15	Adv. Organic Chemistry C–24	30
Chemistry and Dyeing Lab. C–22	135	Physics B–22	45
Stoichiometry C–20	15	Industrial History E–22	15
Mathematics B–20	45	Advanced German E–21	30
		Steam Engineering B–25a	15

Third Year. First Term.

Adv. Textile Chemistry and Dyeing Lect. C–32	30	Adv. Organic Chemistry Lect. C–36	30
Adv. Textile Chemistry and Dyeing Lab. C–32	135	Technical German C–35	30
Industrial Chemistry C–31	30	Wool Finishing H–30	75
Quantitative Analysis C–30	165	Economics E–30	30

Third Year. Second Term.

Adv. Textile Chemistry and Dyeing Lect. C–32	15	Physical Chemistry C–33	30
Adv. Textile Chemistry and Dyeing Lab. C–32	75	Technical German C–35	30
Industrial Chemistry C–31	30	Organic Laboratory C–34	120
Wool Finishing H–30	75	Quantitative Analysis C–30	120
		Economics E–30	30

Fourth Year. First Term.

Physical Chemistry C–44	45	Quantitative Analysis C–47	15
Technical German C–40	30	Dyeing Laboratory C–45	135
Engineering Chemistry C–42	15	Organic Laboratory C–41	90
Adv. Textile Chemistry and Dyeing C–45	30	Industrial Laboratory C–43	45
Textile Testing G–31	15	Thesis C–48	105

Fourth Year. Second Term.

Physical Chemistry C–44	15	Adv. Textile Chemistry and Dyeing C–45	15
Organic Laboratory C–41	105	Technical German C–40	30
Microscopy C–46	45	Engineering Chemistry C–42	30
Dyeing Laboratory C–45	90	Thesis C–48	180
Textile Testing G–31	15		

Course VI. — Textile Engineering.

This course is the four-year general textile course leading to the degree of Bachelor of Textile Engineering (B.T.E.), and aims especially to fit men, in the broadest possible manner, to meet the increasing demands of every branch of the textile industry for men with combined textile and technical preparation. The magnitude and scope of the textile and allied industries fully justify the most thorough technical training possible for all who aspire to leadership in this field.

The student is first thoroughly grounded in those fundamental principles of science upon which all industrial and engineering work rests. The foundation of his textile and technical training is in the subjects of mathematics, physics, chemistry, drawing, mechanics, mechanism, and technology of fibers, and their practical application.

Instruction is given in all of the various branches of textile manufacturing through lectures, recitations and laboratory work. A large proportion of his time is spent in well-equipped textile departments where he studies and operates all of the machinery required in the conversion of cotton and wool fiber into yarns and fabrics. This includes cotton, wool and worsted yarn manufacturing, designing, weaving, knitting, dyeing and finishing. In his last year the course in textile testing acquaints the student with the methods for determining the physical properties of textile fibers, yarns and fabrics.

To properly equip the student to meet the varied engineering problems which confront the mill manager or executive, or to so train him that he may enter those industries closely allied to the textile, instruction is given by lecture and laboratory practice in the several branches of engineering.

Steam engineering considers the problems involved in steam generation and distribution for power, heating and manufacturing purposes, includes the testing of laboratory and power plant equipment, and leads to the design of power plants. The course in electrical engineering includes a study of the generation and transmission of electrical power, the testing of direct and alternating current machinery, and is intended to acquaint the student with modern practice.

Mill engineering familiarizes the student with mill design, construction, heating, lighting, humidification and fire protection. The arrangement of machinery and buildings for most efficient production and economical power distribution is also studied in detail.

During the fourth year the student is required to conduct an original investigation of some textile or allied problem, and to submit the results in the form of a satisfactory thesis before receiving his degree.

The broadening effect of such subjects as English, language, industrial history and economics is carried still further in this course by carefully planned courses in business administration, accounting, cost accounting, business and patent law.

For the student who may desire the breadth of technical training which this course offers, but who wishes to specialize in either cotton or wool manufacturing, two options are offered. In these optional courses the student's entire textile time is devoted to the study of that particular fiber which he elects.

For detailed description of subjects, see page 30.

Course VI. — Textile Engineering (General Course.)

[For first year see page 16.]

Second Year. First Term. (Hours of Exercise).

Chemistry and Dyeing Lect. C–21	30	Engineering Lab. B–26	45
Physics B–22	45	Cotton Yarn Mfg. F–20	45
Mathematics B–20	45	Wool Yarn Mfg. G–20	120
Machine Drawing B–21	75	Language E–20, 21	30
Steam Engineering B–24	45	Industrial History E–22	15
Power Weaving D–22	30		

Second Year. Second Term.

Physics B–22	45	Industrial History E–22	15
Mathematics B–20	45	Power Weaving D–22	30
Machine Drawing B–21	75	Chemistry and Dyeing Lect. C–21	15
Steam Engineering B–25	30	Graphic Statics B–23	30
Yarn Mfg. F–20 and G–20	165	Engineering Lab. B–26	45
Language E–20, 21	30		

Third Year. First Term.

Electrical Engineering B–34	75	Power Weaving D–31	45
Engineering Lab. B–31	45	Mathematics B–30	30
Cotton Yarn Mfg. F–30	60	Mill Engineering B–35	45
Wool Yarn Mfg. G–30	90	Wool Finishing H–30	75
Strength and Materials B–32	30	Economics E–30	30

Third Year. Second Term.

Hydraulics B–33	15	Wool Finishing H–30	75
Electrical Engineering B–34	75	Power Weaving D–31	45
Mill Engineering B–35	45	Mathematics B–30	30
Machine Shop Practice B–36	30	Strength of Materials B–32	30
Yarn Mfg. F–30 and G–30	150	Economics E–30	30

Fourth Year. First Term.

Cotton Organization F–40	75	Power Plants B–42	30
Machine Shop Practice B–40	45	Business Administration B–44	45
Mill Engineering B–43	75	Elements of Accounting B–46	45
Electrical Engineering B–41	75	Thesis	75
Cotton Finishing H–31	30	Electives B–49	
Textile Testing G–31	15	Knitting F–31	15

Fourth Year. Second Term.

Mill Engineering B–43	75	Knitting F–31	15
Electrical Engineering B–41	75	Business Administration B–44	30
Cotton Finishing H–31	75	Cost Accounting B–47	45
Power Plants B–42	30	Business Law B–48	15
Textile Testing G–31	15	Thesis	135
Cotton Organization F–40	15	Electives B–49	

Course VI. — Textile Engineering (Cotton Option.)

[For first year see page 16.]

Second Year. First Term. (Hours of Exercise.)

Chemistry and Dyeing Lect. C–21	30	Steam Engineering B–24	45
Physics B–22	45	Cotton Yarn Mfg. F–20	165
Mathematics B–20	45	Language E–20, 21	30
Machine Drawing B–21	75	Industrial History E–22	15
Engineering Lab. B–26	45	Power Weaving D–22	30

Second Year. Second Term.

Physics B–22	45	Power Weaving D–22	30
Mathematics B–20	45	Language E–20, 21	30
Machine Drawing B–21	75	Industrial History E–22	15
Steam Engineering B–25	30	Chemistry and Dyeing Lect. C–21	15
Yarn Mfg. F–20	165	Graphic Statics B–23	30
Engineering Lab. B–26	45		

Third Year. First Term.

Electrical Engineering B–34	75	Engineering Lab. B–31	45
Mill Engineering B–35	45	Mathematics B–30	30
Yarn Mfg. F–30	90	Strength of Materials B–32	30
Cotton Design D–20	75	Economics E–30	30
Power Weaving D–31	30	Cotton Finishing H–31	75

Third Year. Second Term.

Hydraulics B–33	15	Power Weaving D–31	90
Electrical Engineering B–34	75	Mathematics B–30	30
Mill Engineering B–35	45	Strength of Materials B–32	30
Yarn Mfg. F–30	75	Economics E–30	30
Cotton Design D–20	30	Cotton Finishing H–31	75
Machine Shop Practice B–36	30		

Fourth Year. First Term.

Machine Shop Practice B–40	30	Business Administration B–44	45
Mill Engineering B–43	45	Elements of Accounting B–46	45
Electrical Engineering B–41	75	Electives B–49	
Cotton Organization F–40	75	Knitting F–31	60
Power Plants B–42	30	Thesis	75
Textile Testing G–31	15		
Textile Design D–30	30		

Fourth Year. Second Term.

Cotton Organization F–40	45	Cost Accounting B–47	45
Mill Engineering B–43	75	Business Law B–48	15
Electrical Engineering B–41	75	Electives B–49	
Power Plants B–42	30	Knitting F–31	60
Business Administration B–44	30	Textile Testing G–31	15
Textile Design D–30	30	Thesis	105

Course VI. — Textile Engineering (Wool Option.)

[For first year see page 16.]

Second Year. First Term. (Hours of Exercise.)

Chemistry and Dyeing Lect. C–21	30	Steam Engineering B–25	45
Physics B–22	45	Yarn Manufacture G–20	150
Mathematics B–20	45	Language E–20, 21	30
Machine Drawing B–21	90	Industrial History E–22	15
Engineering Lab. B–26	45	Power Weaving D–22	30

Second Year. Second Term.

Physics B–22	45	Power Weaving D–22	30
Mathematics B–20	45	Language E–20, 21	30
Machine Drawing B–21	75	Industrial History E–22	15
Steam Engineering B–25	30	Chemistry and Dyeing Lect. C–21	15
Yarn Manufacture G–20	165	Graphic Statics B–23	30
Engineering Lab. B–26	45		

Third Year. First Term.

Electrical Engineering B–34	75	Power Weaving D–31	45
Mathematics B–30	30	Engineering Lab. B–31	45
Mill Engineering B–35	45	Strength of Materials B–32	30
Yarn Manufacture G–30	105	Economics E–30	30
Woolen and Worsted Finishing H–30	75		

Third Year. Second Term.

Hydraulics B–33	15	Woolen and Worsted Finishing H–30	75
Electrical Engineering B–34	75	Power Weaving D–31	90
Mill Engineering B–35	45	Mathematics B–30	30
Machine Shop Practice B–36	30	Strength of Materials B–32	30
Economics E–30	30		
Yarn Manufacture G–30	105		

Fourth Year. First Term.

Machine Shop Practice B–40	30	Textile Testing G–31	15
Mill Engineering B–43	75	Business Administration B–44	45
Electrical Engineering B–41	75	Elements of Accounting B–46	45
Worsted Yarn Manufacture G–2	75	Power Plants B–42	30
Woolen and Worsted Design, D–20	45	Thesis	75
Knitting F–31	15	Electives B–49	

Fourth Year. Second Term.

Mill Engineering B–43	75	Cost Accounting B–47	45
Electrical Engineering B–41	75	Business Law B–48	15
Yarn Manufacture G–2	45	Power Plants B–42	30
Woolen and Worsted Design D–20	30	Thesis	135
Business Administration B–44	30	Electives B–49	
Textile Testing G–31	15	Knitting F–31	15

SUBJECTS OF INSTRUCTION.

TEXTILE ENGINEERING DEPARTMENT — B.

Mathematics — B–10. Preparation: Admission Requirements. The work in the first term consists of plane trigonometry, logarithms, and instruction in the use of the slide-rule. Right and oblique triangles are solved by means of natural and logarithmic functions, and the various algebraic relations among the trigonometric functions are proved and used in identities and equations. Significant figures and the use of approximate data in calculations are also discussed.

In the second term, the following topics are taken up: graphical and mathematical solution of quadratic and simultaneous equations, theory of equations, partial fractions, Naperian logarithms, equations of the straight line, and equations of various curves. [Courses IV and VI.]

Mathematics — B–10a. Preparation: Admission Requirements. This subject in the first term is identical with B–10, but excludes some of the topics given in the second term of B–10. [Courses I, II, III.]

Mathematics — B–20. Preparation: B–10. This subject is a continuation of the work of the first year course B–10, and extends throughout the second year of the engineering course. A study of the derivative is followed by the differentiation of algebraic functions and applications of the derivative to maximum and minimum and rate problems. Other topics treated are the circle, parabola, ellipse, hyperbola, indefinite integrals, summation by integration, areas, volumes and pressures.

Mathematics — B–20a. Preparation: B–10a. The work in this subject is similar to the first year of B–20 and is given for students of chemistry and textile coloring. [Course IV.]

Mathematics — B–30. Preparation: B–20. During the third year, applications of calculus to mechanics are emphasized. The topics are as follows: integration by parts, integration by substitution, partial fractions, polar coordinates, centers of gravity, moments of inertia, radius of curvature, deflection of beams and empirical formulas. [Course VI.]

Mechanics — B–11. Preparation: Admission Requirements. Taken simultaneously with B–10. This subject is required as a necessary preparation for all courses, and sixty hours of lecture and recitation time are devoted to it during the first term of the first year. The fundamental principles of this subject are considered absolutely essential to a thorough understanding of the operation of all machinery, textile or otherwise. Some of the topics treated in this course are linear and angular velocity, uniform and accelerated motion, mass, momentum, inertia, effect of force in producing motion, centrifugal force, work, power, energy, principle of moments and its applications, parallelogram and triangle of forces with applications, resolution and composition of forces, the mechanical principles represented by the wheel and axle, differential pulley block, common pulley blocks, jackscrew, worm and wheel, and inclined plane. [All courses.]

Mechanism — B–12. Preparation: B–10 and B–11. This subject is also deemed to be one of those absolutely essential to every student's preparation for the work of the following years, and sixty hours during the second term of the first year are allowed for it. Whereas the principles studied are of general application, textile machinery in particular furnishes an unusually large variety of specific examples, and frequent reference is made to these in the development of the course. Some of the important topics covered are gearing and gear train design, belting and pulley calculations, cone and stepped pulley design, cam design, linkages, epicyclic gear trains, and intermittent motion devices. [All courses.]

Mechanical Laboratory — B–13. Preparation: B–10 and B–11. Taken simultaneously with B–12. This work is given during the second term of the first year, and is supplementary to the course in Mechanics and Mechanisms. Especial importance is attached to the demonstration of the fundamental principles of these

subjects. Some of the experiments and tests made in this course are as follows: —

Determination of coefficient of friction; proof of principle of moments; proof of principle of work; efficiency test of various hoisting and lifting appliances, such as tackle and fall, worm block, differential and triplex blocks, jackscrews, wedges, etc.; experimental proofs of the principles of graphic statics; efficiency tests on belt transmission, including measurement of belt tensions, coefficient of friction, slip, etc.

Tests on various types of absorption dynamometers; calibration of transmission dynamometer; power measurements on textile machinery with differential dynamometer; measurement of friction of steam engine. [Course VI.]

Mechanical Drawing — B–14. Preparation: Admission Requirements. Taken simultaneously with B–11. This course is taken during the first year, and consists of work in the drawing room supplemented by lectures. This subject is considered of the greatest importance as a preparation for the student's future work, and the practical usefulness of drawing of this character is fully emphasized. The course is systematically laid out covering in order the following divisions:—

Care and use of drawing instruments; geometrical constructions; elements of projections and descriptive geometry; isometric projection; developments with practical applications; sketching practice on machine details. [All courses.]

Machine Drawing — B–15. Preparation: B–14. This work is the continuation of Mechanical Drawing, and is pursued throughout the second term of the first year. This work is wholly of a practical character, and includes sketching from the textile machinery details, working scale detail and assembly drawing, tracing and blue printing. The rudiments of machine design to supplement the work in strength of materials is also given. [Courses I, II, III, VI.]

Machine Drawing — B–15a. Preparation: B–14. For students electing the Chemistry and Textile Coloring course in the second term of the first year a course of machine drawing is given similar to B–15, except that it is not as extensive and is concluded in thirty hours. [Course IV.]

Machine Drawing — B–21. Preparation: B–12, B–14, B–15. During the second year the work in Machine Drawing is devoted to advanced graphical mechanism problems. The data for all of these problems are in every case taken directly from some of the textile machines that the students meet in other departments. These problems include cam designs for builder motions, mule scroll layouts, Scaife builder motion analysis, fly frame cone design, mule quadrant motion, analysis of camless winder, and a number of others of similar character. [Courses I, II, III, VI.]

Physics — B–22. Preparation: B–10 and B–11. This subject lays the foundation for later work in engineering and chemistry and also explains the general application of the laws and principles of physics. Instruction, consisting of lectures, demonstrations, and recitations, is given for three hours per week during the second year. The topics taken up the first term are:—thermometry, measurement of heat, change of state, expansion, transfer of heat, humidity, hydrostatics, elements of hydraulics, the vernier, kinetic energy, circular motion, harmonic motion, wave motion and sound.

The second term is devoted to the study of light, magnetism, and electricity. Some of the topics are:—nature and propagation of light, reflection and refraction lenses, the telescope and microscope, the spectroscope, color sensation, double refraction, magnetism, electrostatics, fundamental laws of direct currents and electrolysis. [All courses.]

Graphic Statics — B–23. Preparation: B–10 and B–11. The work in this course is presented by lecture and recitations. First are considered mathematical and graphical conditions for equilibrium for any system of forces, and the subjects of center of gravity and funicular polygons are introduced. Then follow problems on bridge and roof trusses under various conditions of dead, live, wind and snow loading. [Course VI.]

Steam Engineering — B–24. Preparation: B–10, B–11, B–12. The purpose of this course is to familiarize the student with the principles of elementary thermodynamics, the properties of steam, mechanical mixtures, combustion of fuels, types of boilers, and the auxiliaries of the modern boiler house. The course con-

sists of forty-five exercises given in the first term of the second year. The lectures and recitations are supplemented with illustrative problems assigned for home preparation. [All courses.]

Steam Engineering — B–25. Preparation: B–24. This course is a continuation of B–24, and consists of thirty hours of lectures and recitations given in the second term of the second year of the Textile Engineering course. The subjects developed are the kinematics of reciprocating steam engines, steam turbines and gas engines. Special attention is given to the mechanical principles on which the steam engine operates, with detail discussion of the valve gear and governing devices, and the various diagrams used for studying the same. Consideration is given to the underlying heat theory and to the details of construction of the various parts of the machines. During the latter part of the course the historical development, classification and types of turbines and gas engines are discussed. [Course VI.]

Steam Engineering — B–25a. Preparation: B–24. This course consists of fifteen lectures and is supplementary to Course B–24. Its aim is to give those students who do not take the Engineering course a general knowledge of the steam engine, steam turbine and gas engine, and their auxiliaries. One exercise is devoted to an engine test to demonstrate the practical use of the indicator and the advantages of condensing. [Course I, II, III, IV.]

Engineering Laboratory — B–26. Preparation: B–24. The principles underlying the subjects of steam engineering, hydraulics and thermodynamics are demonstrated in a practical manner in the work in the Engineering Laboratory. Greater importance is attached to the development of initiative and responsibility in the student than the mere accomplishment of a large number of carefully planned tests. The character of this work is indicated by the following list of experiments and tests: —

Calibration of scales, tanks, gauges, inductors and counters; barrel, separating, and throttling calorimeter tests; heat exchange tests; boiler inspection and measurement; flue gas analysis; dynamometer tests; ejector and injector tests; Rankin's efficiency, actual thermal efficiency and duty tests; expansion of pipes, radiation and pipe covering tests; boiler test; trap tests, feed water heating tests; steam, triplex and centrifugal pump tests. [Course VI.]

Engineering Laboratory — B–31. Preparation: B–26. This course is a continuation of course B–26. The following list of experiments indicates the character of the work done during the first half of the third year: —

Valve setting by measurement and by indicator; condenser test; non-condensing and condensing engine and turbine tests; heating and ventilating fan tests; lap and butt riveted joint tests; nozzle test; gas engine test, flow of air and air compressor tests. [Course VI.]

Strength of Materials — B–32. Preparation: B–12, 20, B–23. This subject consists of sixty exercises given in the third year of the Textile Engineering course, and in which are discussed, as fully as time permits, such topics as stress, strain, methods of testing materials, bending moments, shearing force, beam design, column design, torsion, design of shafts, compound beams and columns, combined stresses, etc. The subject is preparatory to the work in Mill Engineering of both the third and fourth years, where its practical value and application are clearly demonstrated. [Course VI.]

Hydraulics — B–33. Preparation: B–14, and B–20. This subject is presented by means of lectures covering the principles of hydraulics, including hydrostatics, measurements of flow of water through orifices, pipes, nozzles and over weirs. The different types of turbines are studied with results of tests and rating tables. [Course VI.]

Electrical Engineering — 34. Preparation: B–22. The elementary principles of electricity and magnetism are considered in the lecture course of physics. Their development and application are taken up in this course in a detailed study of the magnetic and electric circuits during the first period of the first term. The second period is devoted to a study of the principles of direct current machinery. The laboratory work consists of a study of technical electrical measurements and dynamo-electric machinery, determining for the latter their operating characteristics.

Weave Room

The second term is devoted entirely to a study of the principles of alternating current circuits, including vector representation, effective values, power, series and parallel circuits. The laboratory work consists of a study of technical electrical measurements, some meter calibration including that of watt-hour meters and a study of alternating current circuits using electrical measuring instruments. [Course VI.]

Electricity — B–34a. Preparation: B–22. This is a short course given in the third year of the manufacturing courses, and consists of thirty lectures covering briefly and in a general way the theory of direct and alternating current generators and motors. [Courses I, II, III.]

Mill Engineering — B–35. Preparation: B–12, B–20, B–21, B–23, B–32. Mill Engineering, as presented in thirty lectures during the third year of the Textile Engineering course, consists of a discussion of the following topics: the selection of a site for a manufacturing plant; the exploration of the subsoils for the footing course of the foundation; wood, concrete and sheet steel piling; design of walls, columns, beams, floors, windows, doors, stairways and roofs.

Sixty hours of drawing room and laboratory practice are devoted to plane surveying, contour plotting, cut and fill calculations, setting of batter boards, alignments of shafting and the study from blue prints of slow-burning construction. [Course VI.]

Mill Engineering — B–35a. Preparation: B–10, B–12, B–21. Mill Engineering, as presented in thirty lectures during the third year of the diploma courses, is largely general in its nature and includes only parts of Course B–35. [Courses I, II, III.]

Machine Shop Practice — B–36. Preparation B–11, and B–12. Systematic instruction is given in the most approved methods of machine shop practice, the object being to familiarize the student with the proper use of hand and machine tools, and the characteristics of the different materials worked. Particular attention is given to the form, setting, grinding and tempering of tools and the mechanism of the different machines involving certain speeds, feeds, etc. The course is so planned that the instruction in each typical operation shall conform as nearly as possible to commercial machine-shop practice on textile machinery. The list of tools which appears under "Equipment" in this Bulletin gives an idea of the scope of the work, which includes chipping and filing, tool grinding and tempering, straight and taper turning, screw cutting, drilling and boring, planer work; milling machine work, including gear cutting. Instruction is also given in the use of woodworking tools, both hand and machine, and in forging. [Course VI.]

Machine Shop Practice — B–40. Preparation: B–36. This is a continuation of Course B–35.

Electrical Engineering — B–41. Preparation: B–34. During the first term a detailed study of the alternator is made, with particular stress on generation of three-phase currents. Methods of pre-determination of alternator regulation are taken up and at least one method compared with laboratory test. Parallel operation of alternators with accompanying instruments and devices are studied in class-room and laboratory. The single phase, three-phase and Scott transformers are considered in turn and their various methods of connecting to line and alternators are systematically studied.

In the second term the induction motor and generator are studied with their particular adaptability to the textile industry. The principal starting devices for this motor are thoroughly taken up. The synchronous motor is studied particularly in relation to its ability to correct power factor. In all the work outlined above, the main features are illustrated profusely in class-room demonstrations and laboratory exercises.

Mill Illumination: Fourteen lectures and six laboratory periods. The various factors entering into the design of lighting installations are carefully considered. Costs and estimates, safety and production, are included in the course.

The laboratory exercises include the study and applications of the photometer, Macbeth Illuminometer and foot-candle meter. The concluding work is the design of a lighting installation for a typical mill room, using the school laboratories for this purpose. [Course VI.]

Power Plants — B–42. Preparation: B–25. This course, which consists of lectures given during the fourth year, takes up the fundamental consideration involved in the planning of a power plant for a textile mill. A standard textbook is used in connection with the lectures, and the problems are taken largely from plans of existing modern plants. The choice of type and size of units for certain conditions are given particular attention. [Course VI.]

Mill Engineering — B–43. Preparation: B–11, B–12, B–21, B–36. This work, given in the fourth year of the Textile Engineering course, covers a wide range of subjects and is of the most practical character possible. All of the student's previous work in engineering and his knowledge of the textile processes are here brought together in the consideration of the larger problems of mill design, construction and organization. After a detailed study has been made of the most modern types of mill buildings, including all calculations and drawings, the student is given the problem of laying out and completely designing a textile mill so far as time permits.

The modern methods of power transmission and the proper arrangement of textile machinery are also given careful consideration. The problems are in every case taken from actual conditions in mills already built or in process of construction. The question of mill heating, ventilation, lighting, humidification and fire protection is also studied, and the time spent in the drawing room enables the student to work out nearly all of the more important problems involved in the design of an entire textile mill plant. The close relation existing between proper plant design and economical production is also considered. [Course VI.]

Business Administration — B–44. Preparation: B–10 and E–30. In recognition of the great advances which have been recently made towards better methods of management, and of the possibilities which may result from its application to the textile industry, a course in business administration has been established to enable the student to understand and apply the principles and details of modern management. The instruction in this course begins with a consideration of the factory location and design and their effect on efficiency of production, after which the proper form of organization for manufacturing establishments is discussed in detail, together with organization charts and records.

This is followed by a study of the details of the work of the various departments, such as purchasing, manufacturing, planning, etc., and includes such topics as purchasing systems, storeskeeping, perpetual inventories, warehousing, scheduling, routing, tracing, timekeeping, motion studies, time studies, mnemonic symbolizing, graphical records, wage systems, etc. Consideration is also given to the important relation of psychology to efficient management. The work is further supplemented by visits to plants where methods of production and management can be observed at first hand by the students. [Course VI.]

Elements of Accounting — B–46. Preparation: B–10 and E–30. The purpose of the course in accounting is to acquaint the student with modern methods of accounting for mercantile and manufacturing businesses. At the same time it gives him a much-needed knowledge of such common elementary business transactions as are involved in the use of checks, drafts, notes, vouchers, bonds and stocks.

It is not the purpose of the course to make the student a proficient bookkeeper or accountant, but the nature of the work necessitates a basic knowledge of double-entry bookkeeping and of the functions of ledger accounts. This is developed in practice in the following manner: During the summer preceding the fourth year the student is required to work up a simple bookkeeping set, thus saving valuable time during the school year and effectively preparing the ground for the instruction work.

The course includes a study of the balance sheet and profit and loss statement, and their construction in proper form. Attention is given to the principles of balance sheet valuation, and to such topics as depreciation in all its phases, sinking fund reserves, and the accounting for bond and stock issues. [Course VI.]

Cost Accounting — B–47. Preparation: B–46. The major portion of the time scheduled for accounting in the second term of the fourth year of the Textile Engineering course is devoted to a study of this important topic. It is designed to give the student a knowledge of the various cost methods in use at the present

time, and involves a thorough discussion of methods of handling and accounting for raw materials, direct labor, and the distribution of overhead expenses. To supplement the instruction, the student is required to work up a cost accounting set. [Course VI.]

Business Law — B-48. Preparation: E-30. Under this subject are given lectures, supplemented by the use of a suitable text, on the law governing contracts, negotiable instruments, sales, bills of lading, real estate and corporation. [Course VI.]

Electives — B-49. Students in the fourth year of the Textile Engineering course will be permitted to elect certain textile subjects as substitutes for part of the time scheduled for engineering subjects. Thus a student is offered an opportunity for specialized study along such lines as will prove most beneficial to him at that time. The selection of elective studies is subject to the approval of the head of the Textile Engineering department and to the possibility of arranging for the same. [Course VI.]

CHEMISTRY AND DYEING DEPARTMENT — C.

Elementary Chemistry (Inorganic and Organic Chemistry) — C-10. Preparation: Admission Requirements. Instruction in Elementary Chemistry extends through the first year, and includes lectures, recitations and a large amount of individual laboratory work on the following subjects: —

Inorganic Chemistry.

Non-Metallic Elements. — Their occurrence, properties, preparation, chemical compounds, etc.

Metallic Elements. — Their occurrence, properties, metallurgy, chemical compounds, etc.

Theoretical Chemistry. — Fundamental laws and the theories of chemistry including chemical action, chemical combination, combining weights, atomic weights, chemical equations, acids, bases, salts, Avogadro's law, molecular weights, formulæ, valence, periodic law, etc.

Throughout this course special attention is given to the relationship which exists between the science of chemistry and the properties of the materials used in the various industries and the chemical reactions depended upon for the maintenance of industrial processes.

The laboratory work of this course includes the experimental study of the above subjects and also a preliminary study of the qualitative detection of the more common metals and non-metals, preparatory to Course C-12.

Organic Chemistry.

This course includes a general survey of the fundamental principles of Organic Chemistry, also a study of the hydrocarbons and their derivatives from the point of view of their structure, preparation and uses. This work, although elementary in character, is of sufficient breadth to prepare the student understandingly for the general lectures upon Coal Tar dyestuffs which are given in Course C-21.

Chemistry Technology of Fibres — C-11. The outline of the lecture course which is given during the second term of the first year is as follows: —

Technology of Vegetable Fibers. — Cotton, linen, jute, hemp, china grass. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Animal Fibers. — Wool, mohair, silk. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Artificial Fibers. — Study of the various forms of artificial silk, the process of manufacture, their properties and action with chemicals, acids and heat. [All courses.]

Qualitative Analysis — C-12. Preparation: C-10 taken simultaneously. Qualitative Analysis is studied during the second term of the first year. The work consists of conferences and laboratory work. The student must become

familiar with the separations and the detections of the common metals and acids by the analysis of a satisfactory number of solutions, salts, alloys and pigments. At intervals during the term short laboratory tests are given as well as the regular written examinations.

No pains are spared to make the course as valuable to the student as possible, and to encourage only thorough and intelligent work.

When sufficiently advanced, students take up the examination of various products with which the textile chemist must be familiar such as testing mordanted cloths, pigments and the various dyeing reagents.

During the latter part of this course a certain amount of time is devoted to the preliminary operations of quantitative analysis, such as the precipitation and washing of such substances as barium sulphate, magnesium ammonium phosphate and calcium oxalate, although no weighings or actual determinations are made.

A student's marks in this subject depend as much upon the neatness and care used in manipulation as upon the actual results obtained. [Course IV.]

Stoichiometry — C–13. Preparation: B–10, C–10. This subject is taken two hours each week during the second half of the first year. The application of the metric system is thoroughly studied, and problems are worked involving the expansion and contraction of gases, determination of empirical formulæ, combining volume of gases and chemical calculations, especially those of quantitative analysis. [Course IV.]

Stoichiometry — C–20. Preparation: C–13. This is a continuation of Stoichiometry C–13, and is taken during the second year as an adjunct to Quantitative Analysis. [Course IV.]

Textile Chemistry and Dyeing — C–21. Preparation: C–10, B–12, B–14.

Operations Preliminary to Dyeing. — Bleaching of cotton and linen; wool-scouring; bleaching, fulling and felting of wool; carbonizing; silk-scouring and bleaching; action of soap.

The bleaching of cotton cloth, yarn and raw stock is studied at length with detailed description of the various forms of kiers and machinery used; also the action of the chemicals used upon the material, and the various precautions that must be taken in order to insure successful work.

Under this heading is also included an exhaustive study of the reagents used in the emulsive wool-scouring process, and their action upon the fiber under various conditions; also the most successful of the solvent methods for degreasing wool.

Water and Its Application in the Textile Industry. — Impurities present, methods for detection, their effect during the different operations of bleaching, scouring, dyeing and printing, and the methods used for their removal or correction.

The important subject of boiler waters is also studied under this heading, with a full discussion of the formation of boiler scale, its disastrous results, and the methods by which it may be prevented.

Mordants and Other Chemical Compounds Used in Textile Coloring and Classified as Dyestuffs. — Theory of mordants, their chemical properties and application, aluminum mordants, iron mordants, tin mordants, chromium mordants, organic mordants, tannin materials, soluble oil, fixing agents, leveling agents, assistants, and numerous other compounds, not dyestuffs, that are extensively used in the textile industry.

Under this heading are included the definitions of various terms and classes of compounds used by textile colorists, such as color lakes, pigments, fixing agents, developing agents, mordanting assistants, mordanting principles and leveling agents.

Theory of Dyeing. — A discussion of the chemical, mechanical, solution and absorption theories, and the various views that have been advanced by different investigators of the chemistry and physics of textile coloring processes.

Under this heading are discussed the general methods of classifying dyestuffs and the definitions of such terms as textile coloring, dyeing, textile printing, substantive and adjective dyestuffs, monogenetic and polygenetic dyestuffs.

Natural Organic Coloring Matters. — Properties and application of indigo, logwood, catechu, or cutch, Brazil wood, cochineal, fustic, tumeric, madder, quer-

citron bark, Persian berries, and other natural dyestuffs that have been used within recent years by textile colorists.

Mineral Coloring Matters. — Under this heading are discussed the properties of such inorganic coloring matters and pigments as chrome yellow, orange and green, Prussian blue, manganese brown and iron buff.

Artificial Coloring Matters. — General discussion of their history, nature, source, methods of manufacture, methods of classification and their application to all fibers.

Special study of basic coloring matters, phthalic anhydride colors, including the eosins and phloxines; acid dyestuffs, Janus, direct cotton, sulphur and mordant colors, including the alizarines and other artificial coloring matter requiring metallic mordants; mordant acid and insoluble azo colors, developed on the fiber; reduction vat colors, aniline black and other artificial dyestuffs not coming under the above heads.

As each class of dyestuffs is taken up, the details of the methods of applying them upon all the different classes of fabrics and in all the different forms of dyeing machines are thoroughly discussed; also the difficulties which may arise in their application, and the methods adopted for overcoming them.

Machinery used in Dyeing. — A certain amount of time is devoted to the description of the machinery used in various processes of textile coloring which is supplemented as far as possible by the use of charts, diagrams and lantern slides.

Most of the important types of dyeing machines are installed within the dyehouse of the school, and the students can be taken directly from the lecture room and shown the machines in actual operation. [All courses.]

Dyeing Laboratory — C–22. Preparation: C–21 taken simultaneously. Besides lectures and recitations upon the subject of Textile Chemistry and Dyeing, practical laboratory work is required. By the performance of careful and systematic experiments the student learns the nature of the various dyestuffs and mordants, their coloring properties, their action under various circumstances, and the conditions under which they give the best results. The more representative dyestuffs of each class are applied to cotton, wool and silk, and each student is obliged to enter, in an especially arranged sample book, a specimen of each of his dye trials with full particulars as to the conditions of experiment, percentage of compounds used, time, temperature of dye bath, etc.

For convenience and economy most of the dye trials are made upon small skeins or swatches of the required materials, but from time to time students are required to dye larger quantities in the full-sized dyeing machines which are described elsewhere.

By the use of a small printing machine the principles of calico printing are illustrated, and by means of the full-sized dyeing machines and vats the practical side of the subject is studied. It is the constant endeavor of those in charge to impart information of a theoretical and scientific character that will be of value in the operation of a dyehouse. [Course IV.]

Advanced Inorganic Chemistry — C–23. Preparation: C–10. The whole subject of Inorganic Chemistry is reviewed during the second year, and many advanced topics are introduced which were necessarily omitted from the first-year course in General Chemistry. [Course IV.]

Advanced Organic Chemistry — C–24. Preparation: C–10. In this course, which consists of lectures and recitations, the principles of organic substitution and synthesis are thoroughly discussed, and as many illustrations are used as time will permit, particularly such as are applied in the arts. The aliphatic series of hydrocarbons and their derivatives are studied for about twenty weeks, the remainder of the time being devoted to the benzine series. The aim of the course is to lay a broad foundation for the study of the chemistry of the artificial dyestuffs. Students are required to work out problems in the synthesis of various compounds, in order to become familiarized with equation writing. [Course IV.]

Quantitative Analysis — C–25. Preparation: C–12, C–13. The object of this course is to teach the fundamental principles of quantitative analysis, and to give the student an opportunity of acquiring skill in manipulating the special apparatus used in analytical procedure.

Typical gravimetric methods are taught the first term. The samples analyzed comprise salts, minerals and ores. Electro-chemical analysis is carried out with the aid of a modern type of apparatus designed for rapid work.

The work of the second term consists of volumetric methods. A number of ores and commercial products, carefully chosen, are analyzed so as to give the student a varied experience.

The laboratory work is supplemented by lectures and recitations. Smith's "Quantitative Chemical Analysis" is used as a text. [Course IV.]

Quantitative Analysis — C–30. Preparation: C–25. The fundamental principles acquired in course C–25 are applied in this course in the examination of materials used in the textile mill, the dye house, and the finishing plant. Among the materials analyzed are water, soaps, oils, textile fabrics, stripping agents, acids and alkalies. The latest and most practical methods are employed. Griffin's "Methods of Technical Analysis" is used as a text. [Course IV.]

Industrial Chemistry (Lecture) — C–31. Preparation: C–23, C–24. During the whole of the third year lectures and recitations are held in industrial chemistry, the course in general following Rogers' "Manual of Industrial Chemistry." Particular attention is paid to those subjects which are of special interest to the textile chemist, as oils, soaps, gas and coal-tar industry, building materials, and the manufacture on a large scale of important chemical compounds, such as the common acids and alkalies, bleaching powders, various mordants, etc. The course is illustrated as far as possible with specimens, diagrams and charts, and the students are given an opportunity to visit some of the industrial establishments in the vicinity of Lowell and Boston. [Course IV.]

Advanced Textile Chemistry and Dyeing — C–32. Preparation: C–21, C–22. This is a continuation of the Textile Chemistry and Dyeing Course of the second year, and includes a review of the second year's work in this subject, with the introduction of many advanced considerations, and, in addition, the following subjects: —

Classification and Construction of Artificial Dyestuffs. — A study from a more advanced standpoint of the classification and constitution of artificial dyestuffs including the various methods used in their production, also the orientation of the various groups which are characteristic of these compounds, and their effect on the tinctorial power of dyestuffs.

The object of this study is to give the student a more complete knowledge of the artificial dyestuffs from the color manufacturer's point of view, which will prove of particular value to those who intend later to enter the employ of dyestuff manufacturers or dealers.

Color Matching and Color Combining. — A study of that portion of physics which deals with color and the many color phenomena of interest to the textile colorist. The lecture work is supplemented with the practical application of the spectroscope and tintometer, and much practice in the matching of dyed samples of textile material.

The primary colors both of the scientist and textile colorist, the results of combining coloring lights and pigments, and such subjects as color perception, color contrast, purity of color, luminosity, hue, color blindness, dichroism, fluorescence and the effect of different kinds upon dyed fabrics, are discussed under this heading.

Each student's eyes are tested for color blindness early in the course, in order that he may be given an opportunity to change his course if his eyes should prove defective enough to interfere with his work as a textile colorist.

A dark room has been provided where various experiments in color work and color matching may be performed.

Dye Testing. — This subject includes the testing of several dyestuffs of each class, subjecting them to the common, color-destroying agencies; the determining of their characteristic properties, and their action towards the different fibers; also the determining of the actual money value and coloring power of dyestuffs in terms of a known standard.

Each student is required to make a record of each color tested upon an especially prepared card, which furnishes a permanent record of all dyestuffs, their dyeing properties, fastness to light and weather, washing, soaping, fulling, perspiration, bleaching, steaming, ironing, rubbing, acids and alkalies.

Union Dyeing. — A study of the principles involved in the dyeing of cotton and wool, cotton and silk, and silk and wool union materials in the production of solid and two-color effects.

Textile Printing. — A thorough study of the whole subject of textile printing, each student being required to produce individually no less than twenty different prints, including the following styles; pigment style, direct printing style, steam style with tannin mordant, steam style with metallic mordant, madder or dyed style, the ingrain or developed azo style, discharge dye style, discharge mordanted style, resist style, indigo printing, aniline black printing.

The different parts of the calico printing machine are thoroughly studied; also the precautions which must be considered in its use, and the arrangement of the dyeing apparatus which must accompany such a machine.

Special attention is paid to the methods of mixing and preparing the various color printing pastes that are used in the above work upon a manufacturing scale as well as experimentally in the laboratory.

Cotton Finishing. — A study of the various processes of finishing cotton cloth and the different materials used therein. The work involves the discussion of the various objects of cotton finishing and such operations as pasting, damping, calendering, stretching, stiffening, mercerizing, beetling and filling, and the various machines used for carrying out these processes.

Mill Visits. — During the third and fourth years visits are made to some of the large dyehouses, bleacheries and printworks in the vicinity. [Course IV.]

Physical Chemistry — C–33. Preparation: C–23, C–24, B–22. Two hours of lectures and recitations per week are given during the second term of the third year and throughout the fourth year. This subject includes a study of the fundamental laws and theories of chemistry, and the application of physical measurements to chemistry with illustrative problems. Special attention is given to textile applications. [Course IV.]

Organic Chemistry Laboratory — C–34. Preparation: C–21, C–23, C–24, C–25. This course, while including practice in the usual methods of organic analysis, and giving excellent training in the principles and manipulations of general organic synthesis, is especially devoted to the synthetic dyestuffs. The student not only prepares many of the representative dyestuffs, but, what is far more important, he carries out all the operations, beginning with coal tar itself. Thus, instead of merely coupling two or more of the foreign imported intermediate products to make a dyestuff, he starts with the basic substances obtained from the coal tar, and makes his own intermediate products. As far as is possible the student will be made acquainted with the problems which might arise in a dyestuff factory, and an excellent opportunity is presented for original work. [Course IV.]

Technical German — C–35. Preparation: E–21, C–21, C–23, C–24. This course consists of the reading of German technical literature, with the object of familiarizing the student with the current German publications in textile chemistry and coloring. [Course IV.]

Advanced Organic Chemistry — C–36. Preparation: C–24. This is a continuation of Advanced Organic Chemistry C–24. [Course IV.]

Technical German — C–40. Preparation: C–35. This is a continuation of Technical German C–35. [Course IV.]

Organic Chemistry Laboratory — C–41. Preparation: C–34. This is a continuation of Organic Chemistry Laboratory C–34. [Course IV.]

Engineering Chemistry — C–42. Preparation: C–23, C–24, C–25. A series of lectures is given upon the general subject of Engineering Chemistry, which includes particularly the consideration of fuels, oils and water from the chemical engineer's standpoint. The elements of chemical engineering are also considered to such an extent as time will permit. [Course IV.]

Industrial Analysis — C–43. Preparation: C–25. The lectures in Engineering Chemistry are very adequately supplemented by work in the Industrial Analysis Laboratory, which is thoroughly equipped with the latest and best apparatus for the testing of fuels, flue gases, and lubricating materials. [Course IV.]

Physical Chemistry — C–44. Preparation: C–33. This is a continuation of Physical Chemistry C–33. [Course IV.]

Advanced Textile Chemistry and Dyeing — C–45. Preparation: C–32. This is a continuation of the third year work in Advanced Textile Chemistry and Dyeing, and includes the following subjects: —

ADVANCED ORGANIC CHEMISTRY (DYESTUFFS). Advanced study of the coal-tar coloring matters, their chemistry, relations of their composition to their coloring power, and the chemistry of their preparation.

ECONOMICS OF THE DYEING, BLEACHING AND FINISHING INDUSTRIES. — A study of the factors to be considered in the establishment of a dyeing, bleaching and finishing plant together with the most essential considerations of its management.

ADVANCED DYEING CONFERENCE. — During the latter part of his course each student will be required to write, for presentation before the other members of his class, a paper upon some assigned subject of general interest. After presentation the subject will be open to discussion and question.

The object of this conference is twofold. First, to give the student experience and practice in systematically looking up an assigned subject, and presenting it before others; and secondly, to bring before the class a greater variety of subjects with more detail than could be covered by the general lectures of the course. [Course IV.]

Microscopy and Photomicroscopy — C–46. Preparation: B–22, C–21, C–23, C–24, C–25. The value of the microscope in a great variety of analytical and industrial applications related to the manufacture, processing and examination of fibrous materials cannot be overestimated. Often facts or conditions may be discovered by its use which could be arrived at in no other way.

In this course the students become acquainted with the broad field of usefulness of the microscope in physical and chemical industrial microscopy and receive instruction in the theory and use of microscopes with their common accessories, and in industrial microscopic technique. In the the laboratory the students do as much work with the instruments and accessories and in the solution of practical and typical problems as time will permit.

In conjunction with the course on microscopy and leading up to photomicrography, the students are given an excellent ground work in photography in which, by lecture and laboratory work, all of the common photographic processes are explained and performed.

With this preliminary training in microscopy and photography the students are then introduced to the difficult art of photomicrography and do as much work therein as time will allow. Both the microscopical laboratory and the photomicrographic laboratory are well equipped. [Course IV.]

Quantitative Analysis — C–47. Preparation: C–30. This course consists of lectures, recitations and quizzes on the theory of analytical procedure, and the sampling of materials. [Course IV.]

Thesis — C–48. Before graduation the student must present a thesis which shall consist of a report of some original investigation or research that he has conducted while at the school.

A relatively large number of hours are specially set aside for this work, and students are encouraged to select some object for their investigation which shall be of practical as well as theoretical interest. [Course IV.]

TEXTILE DESIGN AND WEAVING DEPARTMENT — D.

Textile Design and Cloth Analysis — D–10. During the first year instruction is given in the subject of classification of fabrics, use of point or design paper, plain fabrics, intersection, twills and their derivation, sateen, basket and rib weaves, checks and stripes, fancy weaves, including figured and colored effects; producing chain and draw from design, and *vice versa;* extending and extracting weaves.

This subject takes up in a systematic manner the analysis of samples illustrating the various cloth constructions for the purpose of determining the design of the weave and the amount and kind of yarns used, and forms the basis of calculation in the cost of reproducing any style of goods. The various topics discussed are reeds and setts; relation and determination of counts of cotton, woolen, worsted, silk and yarns made from the great variety of vegetable fibers; grading of yarns, folded, ply, novelty and fancy yarns; application of the metric system to yarn calculation;

problems involving take-up, average counts, determination of counts of yarn, and weight of yarn required to produce a given fabric. [First term, all courses.] [Second term, Courses, I, II, III, VI.]

Textile Design and Cloth Analysis — D–20. For Cotton Goods — Preparation: D–10. During the second year consideration is given to fancy and reverse twills, diaper work, damasks, skip weaves, sateen fabrics with plain ground, backed fabrics, and multiple ply fabrics. Students are required to make original designs and put the same into the loom. Special attention is given to the consideration of color effect.

During the first term free hand drawing is taught by means of plates, and practice in coloring is given in conjunction with this work.

Practice, in lettering, spacing and general arrangement of designs and sketches is given. The engineering alphabet is used in all work.

During the second term instruction is given in drawing, sketching, coloring and designing, with reference to their application in textiles. Good examples of applied design in textiles, as well as in other branches, are used as a basis for modified designs selected and composed by the student. This stimulates originality as well as teaches the student to appreciate good designs and color.

The analysis of these fabrics forms a part of the course in design. This also includes the necessary calculations required to reproduce the fabric or to construct fabrics of similar character. [Courses I, III, VI.]

Textile Design and Cloth Analysis — D–21. For Woolen and Worsted Goods — Preparation: D–10. During the second year the instruction given includes warp and filling backed cloth, figured effects produced by extra warp and filling, double cloths, multiple ply fabrics, cotton warps, blankets, bath robes, crêpes, filling reversible, Bedford cords, imitation furs, crépons, matelasse and imitations, double plain, ingrains, velvets, corduroys, overcoatings, trouserings.

The analysis of these fabrics, together with the consideration of the shrinkages and dead loss in all fabrics, theory of diameter of yarns, and costs of mixer blends, is a part of this course. [Courses II, III, VI.]

Textile Design and Cloth Construction — D–30. Preparation: D–20 or D–21. The advanced work takes up the more complicated weaves adapted to harness work, and leads into leno and Jacquard designs. The following is a brief list of the subject heads, which will give some idea of the course: double plain cloths, ingrains, tricots, chinchilla, tapestry, blankets, upholsteries, spot weaves, pile or plush, crêpon, matelasse and its imitations, piqué, Marseilles, quilting, and miscellaneous designs for Jacquard, leno, fustian, tissue fabrics and lappets.

Original designs and sketches for particular grades of goods and the study of color effects form an important part of the third-year course. It should be understood that work in decorative art is carried on in conjunction with textile construction and weaving, particularly on the Jacquard loom. Designs of merit are carefully developed in detail and woven into cloth.

The work in cloth construction includes the application of the different weaves and their combinations in the productions of fancy designs, both modified and original; the calculation involved in the reproduction of standard fabrics changed to meet varying conditions of weight, stock, counts of yarn and value; and the discussion of the breaking strength of fabrics and relationship of the construction of the fabric to breaking strength.

Instruction in this subject, which is given by classroom work is intended to bring together the principles considered under the subject of design, cloth construction, weaving and yarn making of previous years, and to show the bearing each has in the successful construction of a fabric. [Courses III, VI.]

Decorative Art for Special Students. — This course is planned to give a student a working knowledge and appreciation of design. The first and second years are devoted to a general study of design, color, perspective, lettering and rendering. Drawings are made in the historic styles for all materials, — wood, gold, silver, copper, brass, leather, fabrics, wall papers and glass.

In the third year students should specialize and devote their attention to the material in which they expect to work.

Power Weaving — D–22. Preparation: D–10. In connection with the work in Textile Design and Cloth Analysis practical work is carried on upon the power

looms. This includes the preparation of warps, beaming, dressing, sizing, drawing-in and making of chains, the cutting and lacing of cards, spooling and quilling and the machinery for the same. A study is made of warpers and sizing machines, both for cotton and woolen. Lectures are given to correspond with the progress of the student in the Power Weaving Laboratory covering the following subjects: loom adjustments, chain building, shuttle changing looms, dobby looms, single and double acting dobbies, handkerchief motions, leno weaving, center selvedge motion, filling changing looms, oscillating reeds, lappet motions, various shaker motions, towel and other pile cloth weaving, Jacquard looms, single and double lift leno Jacquards, Jacquards of special design, tying up Jacquard harness. [Courses I, II, III, VI.]

Power Weaving — D–31. Preparation: D–20, D–21, or D–22. Instruction is given in weaving on fancy woolen and worsted looms, single and double acting dobbies, leno weaving, various shaker motions, lapper loom weaving, double and single lift Jacquard looms, tying up Jacquard harness, leno Jacquard, harness and box chain building; warp preparation for woolen and worsted and cotton; formulas for making up different kinds of sizing. Lectures are given to correspond with the same. [Courses, I, II, III, VI.]

LANGUAGE AND HISTORY DEPARTMENT — E.

English — E–10. Preparation: Admission Requirements. A technically trained man should be able to express himself clearly, forcibly and fluently, as inability to do so will be a serious handicap to him in after life. The object of the English course is to develop the student's power of expression by a thorough study of the principles of advanced rhetoric and composition, and by constant writing of themes illustrative of the four forms of discourse, viz., description, narration, exposition and argumentation. In addition to the study of rhetoric and composition and the writing of themes, several classics such as are not read in the preparatory schools are studied and discussed. [All courses.]

Elementary German — E–11. Preparation: Admission Requirements. This course is intended for first-year students who do not offer German as an entrance requirement and who desire to take the course in chemistry and Textile coloring. It may be selected by students taking the Textile Engineering course who have not fully met the entrance requirements in language. The work is elementary in character, and much time is devoted to the study of the rudiments of German grammar with practice in composition. During the latter part of the year considerable attention is given to the reading of ordinary German prose, which serves as an additional preparation to the student for the later reading of works along scientific and industrial lines.

Elementary French — E–12. Preparation: Entrance Requirements. This course is intended for first-year students, who elect the Textile Engineering course and who have had two years' work in this subject. Facility in translation is acquired by a considerable amount of reading from general or scientific sources.

Advanced French — E–20. Preparation: E–12. For students who are pursuing the Textile Engineering course and offer two years' preparatory school work in French, a course in translation of scientific French is required during the second year. [Course VI.]

Advanced German — E–21. Preparation: E–11. For students who are pursuing a degree course the elementary course of the first year is continued throughout the second year. The work consists of the study of some of the more advanced principles of grammar, and especially of the reading of scientific German dealing with a variety of subjects, and the translation of commercial German. [Courses IV, VI.]

Industrial History — E–22. Preparation: Admission Requirements. The economic history of a nation is not less interesting or dramatic than its political history, while it is absolutely essential to a thorough understanding of modern business conditions. The object of this course, which is intended for second-year students, is to trace the development of the three leading industrial nations of the world, viz., the United States, England and Germany, from simple, isolated agricultural communities to the complex, industrial and commercial society of to-day. The course consists of weekly lectures supplemented by textbook reading. Among

the topics treated are natural resources; colonization, territorial expansion; manufactures; agriculture; finance; commerce; transportation; revenue tariffs; monopolies; governmental regulation; organization of labor; industrial legislation; immigration; conservation; contemporary problems. During the year each student will be required to write two or more theses on subjects connected with industrial history, in order that he may have practice in research work and also may continue his training in English. [All courses.]

Economics — E-30. Preparation: E-10, E-22. This course consists of lectures supplemented by recitations based upon both the lectures and a textbook. The character of the course is descriptive rather than theoretical, and the aim is to acquaint the student with the accepted principles of economics and some of their applications to industrial conditions.

Among the topics discussed are the nature and scope of economics; the evolution of economic society; the three factors of production, land, labor and capital; the four elements in distribution, rent, wages, interest and profits; business organization; value and price; monopoly; money, credit and banking; international trade; protection and free trade; transportation; insurance; economic activities of municipalities; and public finance. In short, the course deals with the fundamental principles that underlie a wide range of activities. [Courses IV, VI.]

COTTON DEPARTMENT — F.

Cotton Technology of Fibers — F-10. This general course of lectures, given during the second term of the first year, covers in a broad way the manufacture of cotton into yarns. The instruction covers the classification, grading and stapling of cotton, a study of the mechanical operations in yarn manufacture, a consideration of the product and waste of each of the operations, and the uses for which various yarns are suited. [All courses.]

Yarn Manufacture — F-20. Preparation: B-10, B-12, B-14. Instruction is given by means of lecture and laboratory work. The outline of the course is as follows: —

Fiber. — Before taking up the details of the operation of manipulating the fiber into yarn, a careful study is made of the characteristics and classification both botanically and commercially, of the many varieties of the cotton fiber. Methods employed in cultivating, marketing, grading and stapling are considered, and under these heads a detailed study is made of the types of gin employed.

Opening and Picking. — Instruction in the preliminary operation of opening and picking covers the mechanical construction of the machines, their parts and adjustments, as fully as the manufacturing results accomplished by the machines. This includes such construction details as evener, lap measuring and safety stop motion, grids, cleaning trunks, beaters, etc.; also operation details which involve the adjustment of waste, drafts and character of laps.

Carding. — The process of carding is considered one of the most important, and proper time is devoted to the construction and operation of cards that the student may be familiar with the various parts of the card and the function and design of each. The construction and application of card clothing, as well as the methods of grinding, form a part of the work.

Combing. — This process is explained by lecture work and by operation and assembling of the various types of combs in service in the laboratory. The object of combing is fully considered, and the different means employed on the many types of combers on the market is studied. This includes such types as the Heilman, New Whitin and Nasmith combers.

Drawing. — Under this head is taken up the theory of doublings and their effect upon the quality of roving and yarn. Like previous and subsequent processes the machine construction forms an important part of the work. Proper stress is paid to such subjects as stop motions, drawing rolls and their covering, cleaners and evener motions.

Roving Processes. — Under this head are studied the various machines known as the slubber, intermediate, fine and jack fly frames. The relative motion of the various parts of these machines is so complex that a good opportunity is here presented to fix in the student's mind the application of certain mechanical principles that are used in other departments and upon other machines in the manu-

facture of textile material. With each process of yarn manufacture are explained the systems of sizing and numbering, and under this head are taken up both the metric and English systems. [Course I.]

Yarn Manufacturing — F-20a. Preparation: B-10, B-12, B-14. This course is similar to course F-20, except that there is much less time devoted to laboratory work. [Courses III, VI.]

Yarn Manufacture — F-30. Preparation: F-20. RING SPINNING AND TWISTING — The consideration of spinning yarn by the ring frame method involves a knowledge of the uses to which the yarn is to be put, subsequent methods of handling that proper roving may be selected, suitable amounts of draft and twist provided, correct size of rings and travelers selected, building motions suitably adjusted, etc. The operation of twisting yarns is so closely related to spinning by the ring method that it is studied at the same time. This opens an almost limitless field of novelty yarn manufacture, and offers a very good opportunity to derive new types of yarn or new mechanism to produce the effects. Yarn defects are studied with reference to the cause and remedy.

MULE SPINNING. — This method of spinning is very different from that of the ring frame, and the mechanical details are more complicated. The student is furnished with new means of producing yarns, and can compare the relative advantage of each method. A thorough understanding of mule spinning is perhaps more a study of mechanical motions and their functions. This results almost invariably in assisting the student to understand previous processes and machines better because of his work on the mule. It is the object to make clear to the student's mind the principles underlying the construction and operation of the parts that control the drawing, twisting, backing off, winding, together with such special motions and devices as are used upon the modern mule.

SPOOLING. — This subject involves a study of the various types of spoolers, spooler speeds, tensions and production.

WINDING. — The different makes of winders, the packages they make, the peculiarities, special features and production of each are discussed in this work.

REELING. — Under this topic is included the construction of the machine, the types of winding possible, the quantity of yarn in a skein, and the packing of skeins into bundles. [Course I.]

Yarn Manufacturing — F-30a. Preparation: F-20a. This course is similar to Course F-30 except that there is much less time devoted to laboratory work. [Courses III, VI.]

Knitting — F-31. Preparation: B-12, D-10. This course, commencing with a study of hosiery yarns and their preparation for knitting, includes a study of the various stitches and their application in commercial fabrics; a study of the different knitting machines, including circular and flat spring and latch needle machines used in the manufacture of stockings, sweaters and underwear; and a study of looping and sewing machines. Part of the work consists of the assembling and adjusting of different types of knitting machines.

In addition, considerable time is spent in the analysis of knitted fabrics. [Courses I, II.]

Knitting — F-31a. Preparation: B-12, D-10. This course embraces the same lectures as Course F-31 but does not include any laboratory work. [Courses III, VI.]

Cotton Organization — F-40. Preparation: F-30. Following the detailed study of the individual processes it is necessary to consider the relation of each to the other, the programs, balance of production, cost of machinery for various counts, quantities and styles of yarns. Under this heading are also studied such subjects as depreciation of machinery, cost systems, economics, arrangement of machinery, power demands, etc. [Courses I, VI.]

WOOL DEPARTMENT — G.

Technology of Fibers — G-10. The principles of converting loose fibrous materials into continuous twisted strands called yarn are discussed, and the nature and uses of spindle drawn and roller drawn yarns explained. Particular attention is given to the nature and processing of wool, allied fibers and reworked fibers. The source of supply, original and clean cost, and the effect of tariff and exchange on

fibers and processed materials from foreign countries, illustrated by examples. [All courses.]

Top Manufacture — G–20. Preparation: B–10, B–12, B–14. Raw Materials. — A study of raw materials which enter into the manufacture of woolen or worsted yarns, or are made into yarns by processes similar to those employed in the manufacture of woolen and worsted yarns, would include silk, mohair, alpaca, vicuna, cashmere, camel's hair, cotton, flax, hemp, jute and ramie. In connection with these are considered shoddy, noils, mungo and extracts.

Wool Sorting. — Familiarity with the various grades and kinds of wool is obtained by lecture and by actual sorting of fleece wool under the direction of an experienced wool sorter. The various characteristics and properties are explained, as are also trade terms, such as picklock, XXX, XX, ½-blood, ⅜-blood, ¼-blood, delaine, braid, etc. Some skill is acquired in the estimation of shrinkage and in judging the spinning qualities.

Wool Scouring. — The object of scouring and the methods employed are explained, and this involves the consideration of the soaps and chemicals used in washing; also the waste products and their utilization. Actual work is done in scouring a commercial quantity of wool by machines that are made similar in operation to regular commercial machines. A study is made of the effect of the hardness of water upon soap; also tests are made to show this effect. At the same time the use of dryers, their operation and regulation, is taken up, and the methods of carbonizing wool, noils, burr waste, rags, etc., are studied and practiced.

Burr Picking, Mixing and Oiling. — In these processes, preliminary to carding, the students have an opportunity of mixing various colors of wools to produce different effects, and the influence of varying percentages of a given color in a mixture can be seen. Each student is required to make at least twenty sample mixes combining different colors and grades of stock, and to felt and mount the same. Under the subject of oils and emulsions are taken up the characteristics of various oils and the means employed to test these. The use of mixing and burr pickers is made clear.

Carding. — The different systems of carding wool, depending upon whether it is to be made into woolen or worsted yarn, are fully explained, as is also the construction, setting and operation of the cards. A part of the work is the reclothing and grinding of the cylinders, strippers, workers, etc. The carding of suitable and commercial quantities of wool, and the further manufacture of it into yarn, serves to fix the principles of carding in the mind of the student, as well as to give him some skill in handling machinery. At the completion of this part of the work he is required to prepare and hand in a full description of the process of carding, including working drawings, sketches, etc., to fully explain the machines and the methods.

Woolen Mule. — The student studies thoroughly the operation of the mule as a whole, and acquaints himself with the various principal mechanisms, as, for example, the backing off and winding motions, the quadrant, builder-rail, faller regulation, etc.

Top Making and Combing. — This branch takes up, besides the carding of the wool on a worsted card, the preparing processes, back-washing and Vigoureaux printing, also gilling of the stock before and after combing. The construction of the gill boxes and combs is studied by lectures, and by dismantling and assembling these machines in the laboratories. Later, quantities of stock are made into top and then into yarn.

The Noble comb is studied, and the various calculations to determine draft, noiling, tear, productions, etc., are made. [Courses II, III, VI.]

Yarn Manufacture — G–30. Preparation: G–20. Intersecting Gill Boxes and French Comb. — The equipment of the laboratory offers opportunity for the production of dry combed top and its comparison with oil combed top produced on the Noble comb. The structures and uses of intersecting gill boxes and the study of combing and drawing blends is taken up at this point.

Drawing and Spinning. — The laboratory equipment consisting of the Bradford (English) system of drawing, of both open and cone types, as well as the various processes of French drawing, followed by both worsted mule and ring spinning

frame, make possible a thorough study of the manufacture of worsted yarn by all of the existing methods.

The same method of study of mechanisms, calculations, and operations of the various machines is followed as in the case of previous methods of instruction. The student by pursuing this course can compare the different methods of yarn manufacture and note the results of each.

Organization. — At the end of the course the layout of a properly balanced yarn mill is studied, and at the same time the cost of machinery, depreciation, labor costs and machinery arrangments.

Thesis. — Before graduation, the student must present visible evidence of his knowledge of woolen and worsted manufacture by the production of twenty yards of fabric from his own design (or reproduction or modification of some existing fabric) beginning with the raw material.

A formal typewritten description, including all calculations and observations, together with samples from each machine, must be presented to the head of the department before the final examination. [Courses II, III, VI.]

Textile Testing — G–31. Preparation: B–22, F–30 or G–30, D–22. The object of this course is to familiarize the student with present-day methods of determining the physical properties of textile fibers, yarns and fabrics. The application of physical laws and methods of measurements, as studied in the Course of Physics, is used in the study of physical characteristics of textile material. The work is given to students in advanced courses, and consists of lecture and laboratory work. Reports are prepared from each experiment, giving the object of the experiment, method of procedure, observation and conclusions, in order that the student may acquire practice and understand the interpretation of data. A special testing laboratory is provided, and a considerable number of the best standard fiber, yarn and fabric testing instruments of foreign and American make have been installed and are used for instruction in the testing of textile materials. The laboratory is equipped with means for making and keeping the humidity constant, so that tests can be made under uniform or standard conditions of humidity and temperature. [All courses.]

FINISHING DEPARTMENT — H.

Woolen and Worsted Finishing — H–30. Preparation: B–12, C–10, D–10, D–22. The outline of this course, which is given by means of lecture and laboratory work, is as follows: —

Burling and Mending. — Under this head is taken up for consideration the examination of flannel as it comes from the loom; the construction, use and location of the perch; the methods used in marking defects, measuring, weighing and numbering of cloths; also the methods of inspection for fancies, single cloths and double cloths. The object of burling, mending and the types of tables employed, the method of removing knots, runners, etc., the object of back shearing and the use of burling irons, the replacing of missing threads and the importance of sewing as a part of the finishing process, are all considered in detail. The removal of oil and tar spots as well as stains of various kinds is studied.

Fulling. — This branch covers a study of the conditions of the flannel as it comes from the loom, and the influence of oil, etc., upon the procedure. Considerable time is devoted to the various methods of producing a felt, the early types of stocks, hammer falling and crank stocks, and their modifications and develop ment into the present type of rotary fulling mills of both the single and double variety. The details of construction in all machines are carefully taken up and include the design and composition of the main rolls, methods of covering, regulation and means of adjusting the pressure of traps and rolls, consideration of the shoes, the use and regulation of the various types of stop motion, the different types of stretchers, guide rolls and throat plates.

The theory of felt is taken up and the influence of pressure, moisture, heat, alkali and acid is considered, as well as the hydroscopic and felting properties of different wool fibers. The preparation of the flannel for the mill and the usual methods of determining shrinkages, as well as the various methods of soaping, are given careful attention. The preparation of various fulling soaps and the value of each for the production of various degrees of felt as well as the determination of the proper

amount of alkali for various goods, are carefully studied and demonstrated. The manipulation of the various kinds of goods in the mill, viz., all wool, shoddies and mixed goods, is studied in classroom and by operation in the mill.

The change in weight and strength for each operation is carefully considered, as is also the value of the flocks made in each. A study of the various methods of flocking, such as dry and wet, is considered in both class and machine rooms. In each operation the defects likely to materialize are studied, as well as the cause thereof, and various methods of modifying or lessening them.

Washing and Speck Dyeing. — This branch considers the scouring, rinsing and washing of goods both before and after the fulling process; the various types of washers; and the details of construction, such as suds box, rolls, etc. The theory of scouring, uses of Fuller's earth, salt solutions and scours on the different kinds of goods are made clear by practical work in the machine room, where the effects due to improper scouring, such as stains, cloudy effects, wrinkles and unclean goods, are demonstrated. The discussion of the necessity of speck dyeing follows naturally from the study of these matters, and includes methods of preparation, materials used, application and tests required.

Carbonizing. — This is an important branch of finishing, and includes a study of the various carbonizing agents, methods of application, strength of solutions, and neutralizing, as well as the machines used. Stains and imperfections resulting from carbonizing are also considered. The drying and tentering machines and extractors employed are taken up at this point.

Gigging, Napping, Steaming, Singeing and Crabbing. — The construction in detail of the various types of gigs, nappers, steamers, wet gigs, rolling, stretching, crabbing and singeing machines is discussed, and their actions upon the cloth and the results obtained are explained.

Various methods of obtaining luster and the production of permanent finish are considered in connection with steaming and sponging.

Brushing, Shearing and Pressing. — This includes, as do the other branches, a careful treatment of the machine employed, the preparation of the cloth for each process, the action of each machine in producing its part of the resultant effect. In manipulation of the shear consideration is given to its setting, grinding and adjustment. With the brushing machine the effect of steaming and moisture upon the luster and feel of the goods is shown. A study of the action of the presses, both plate and rotary, involves consideration of pressure, steaming, etc. Special processes to obtain particular effects are taken up, and the part played by each machine is explained. The details involved in handling cloth on a commercial scale, as, for example, measuring, weighing, ticketing, numbering and rolling, are also explained. The necessary calculation and the methods of finishing all grades of goods are considered from time to time during the year. [Courses II, III, IV, VI.]

Cotton Finishing — H-31. Preparation: B-12, C-10, D-10, D-22. The outline of the course in the finishing of cotton fabrics is as follows: —

Cloth Room. — Instruction of the various goods and the object thereof; construction of the various types of inspecting and trimming machines.

Shearing. — The object. A consideration of the various types of shears for treating one or both sides at the same time; also the use of the usual cleaning devices, such as emery, sand and card rolls, beaters and brushes; grinding and the adjustment of the various parts.

The use of brushing and cleaning machines, rolling devices and calender attachments for gray goods.

Singeing. — Developing and object of singeing; the construction of singers of all types, and for various purposes; the use of cooling tanks, steaming devices, rolling and brushing attachments.

Regulation of the flame for various goods, and adjustment of the parts; gas; and air pressure, water-cooled rolls; the effect of moisture on the cost of singeing and use of dry cans in connection with singeing; electric singeing.

Washing. — Open width and string washers, their construction and operation: soaps, temperature, squeeze rolls; washing of various goods and the object thereof; stains.

Napping. — The object of napping and the usual method of treating goods;

various types of nappers, single and double acting; felting nappers; construction, grinding and adjustments of various types.

Water Mangles. — Their objects and the construction of various types; various rolls, iron, husk, etc.; scutchers, their object and constructions.

Starch Mangles. — The object and construction of all types of starch mangles for pure starch and filled goods; various types of rolls, brass, rubber, wood; action of doctor blades, etc.; regulation and object of pressure.

Methods of starching and finishing all standard goods, also a consideration of the various substances used, such as starch, softener and fillers; the preparation of starch and various methods of application.

Dryers and Stretchers. — Both horizontal and vertical types of drying cans, tenter frames, clips, etc.; the swing motion and the finishes thus produced; object and construction of spraying machines, belt stretchers, short tenters, button breakers, etc.

Calenders. — The object and construction of all types, including the regulation of pressure and nips for the production of various finishes; various types of rolls and their uses, — steel, husk, cotton, paper, etc.; the use of hot and cold rolls; chasing, friction, embossing and schreiner calenders, and the various finishes produced by each; production of watered effects; beetling machines and hydraulic mangles.

Making up room, — yarding, inspecting; different types of folds; pressing, papering, marking. [Courses I, III, VI.]

PHYSICAL EDUCATION — I.

All members of the freshman class are required to take a course in physical training conducted in the gymnasium under the direction of an instructor in physical education. Two periods per week for the entire first year are devoted to this work. At the beginning of the year a full record is made of the physical examinations carried on by the instructor and a reputable physician that proper and beneficial exercise may be prescribed.

The object is to give general instruction in the care and strengthening of the body, and to so guide the students that they may continue to give proper throught to their physical training that their mental development may have its greatest effect.

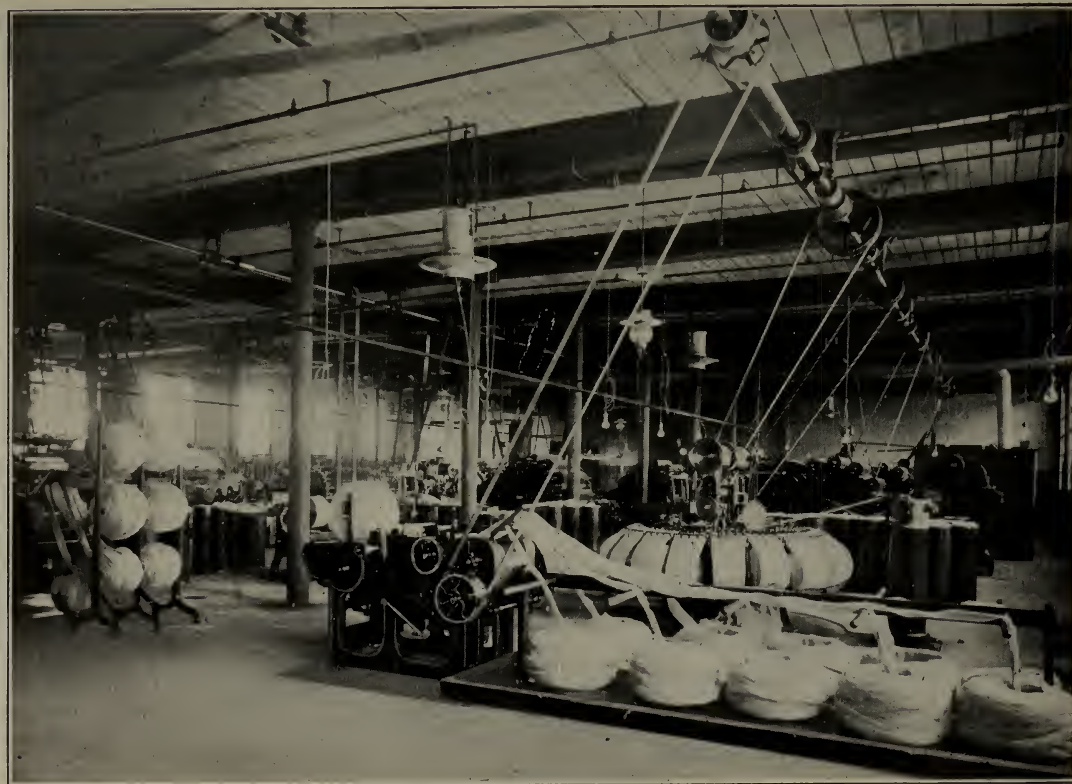
Proper gymnasium clothing is required and all students must take a shower bath following each exercise.

BUILDINGS AND GROUNDS.

The site is a commanding one, consisting of about 15 acres at a high elevation on the west bank of the Merrimack River. It extends to and overlooks the rapids of Pawtucket Falls, which was the first water power in America to be used on an extensive scale to operate power looms. It was contributed by Frederick Fanning Ayer, Esq., of New York City, and the Proprietors of the Locks and Canals on the Merrimack River.

Southwick Hall, the main building, fronting on Moody Street, was contributed by the Commonwealth of Massachusetts and Frederick Fanning Ayer, Esq., and is a memorial to Royal Southwick, a leading textile manufacturer, a public man of earlier days, and a maternal ancestor of Mr. Ayer. It includes a central mass 90 by 90 feet, having three stories and two wings 80 by 85 feet each with two stories and well-lighted basements. The building is pierced in the center by an arched way from which access is had to the wings and to the central courtyard. The northern wing is occupied by the General Offices, Engineering and Finishing departments, and Library, while the southern wing is entirely occupied by the Chemistry and Dyeing departments.

Kitson Hall, dedicated to the memory of Richard Kitson, was contributed by Charlotte P. Kitson and Emma K. Scott, his daughters; the Kitson Machine Company of Lowell, founded by Mr. Kitson, was also a generous contributor. This hall makes a right angle with Southwick Hall, is 70 by 183 feet, and has two stories and a basement. The first floor is occupied by the Cotton Yarn and Knitting departments, while the basement contains the Mechanical and Electrical Engineering laboratories and the Machine Shop.



Wool Combing

The Falmouth Street Building forms the third side of the quadrangle, and consists of three portions, one 60 by 75 feet, three stories, one 75 by 130 feet, three stories, and the head house 70 by 80 feet, three stories and basement. The building is occupied by the picker section of the Cotton Yarn Department, the Design and Power Weaving Department and by the Woolen and Worsted Yarn Department, and contains on the lower floors an equipment for the manufacture of wool yarn from the fleece to the finished yarn. The upper floors are occupied by a great variety of plain, dobby and Jacquard looms, and in a section of the building are the students' lockers and recreation rooms.

Colonial Avenue Building was erected in the summer of 1910 from plans prepared by the Engineering Department, which also had in charge the work of construction. The building completes the fourth side of the quadrangle, and in outward appearance corresponds to the architectural features of the other school buidings. It is a single-story building, and has the dimensions of 195 by 60 feet Its interior is faced with cement brick made at the school during the progress of the work. These serve to give light reflecting walls which are advantageous for the work of the Wool Manufacturing, Cotton Finishing and Chemistry and Dyeing departments that occupy this building. The funds for this building were provided by the State of Massachusetts.

The buildings are all built of light brick with granite and Indiana limestone trimmings. They are of modern mill construction adapted to educational uses. The floor space of the several departments is as follows: —

	Square Feet
Cotton Yarns and Knitting	21,600
Woolen and Worsted Yarns	28,160
Textile Design and Decorative Art	16,806
General Chemistry and Dyeing Laboratories	28,400
Finishing Cotton, Woolen and Worsted	10,606
Power Weaving	15,360
Textile Engineering	24,297
Power plant	10,047
Assembly and physical culture halls	10,800
Entrances, corridors, stairways, etc.	14,487

Additional floor space is devoted to Administration, Offices, Library, classrooms, storerooms, etc.

CAMPUS.

Through the generosity of Mr. Frederick Fanning Ayer the school has been provided with a campus and athletic field of about 3 acres. This has been carefully graded and laid out for baseball, football and track athletics.

To enclose this field the Alumni Class Fence has been partly built. It is made of forged iron sections supported between brick columns. Each section is contributed by a class, so that in the course of a few years this fence will entirely enclose the field.

On the upper floor of the Falmouth Street Building there has been provided a recreation room for the use of the students at such times as their attendance is not required in classes.

In the basement of this building there are rooms for the use of the athletic teams. Connected to these are showers and dressing rooms.

The upper hall of Southwick Hall has been equipped with gymnastic apparatus. Chest weights, wooden dumb-bells, Indian clubs, a set of traveling rings, a vaulting horse, parallel bars, a punching bag and several sets of foils and single sticks have been provided.

In order to be sure that no student having any dangerous physical weakness takes part in any athletic contest, all candidates for the various athletic teams are obliged to pass a satisfactory physical examination.

EQUIPMENT.

The equipment of machinery, inventoried at $330,850.00, is most varied for textile educational purposes, and is being constantly augmented. The builders of the various machines installed keep in close touch with the school, adding to the machines such improvements as are made from time to time, and each year some new machine will be added by a manufacturer who finds it to his advantage to be represented here. This operates to the mutual advantage of student and manufacturer.

Cotton Yarns Department. — The opening and picking section of this department contains a 40-inch two beater breaker lapper with automatic feeder, a 40-inch single beater intermediate and finisher lapper with Perham & Davis sectional plate evener, apron to double four laps, with an extra Kirschner patent carding beater, roving waste opener and a thread extractor, all of which have been installed by the Kitson plant of the Saco-Lowell Shops at Lowell.

There is a 50-saw gin from the Daniel Pratt Gin Company of Prattville, Alabama, besides facilities for teaching the grading and classification of cotton.

The carding, combing and drawing section contains the following machinery from the Saco-Lowell Shops: — a top flat card, three revolving flat cards, two of which form a unit for waste carding, three railway heads and two drawing frames. One of these cards is equipped by the Chapman Electric Neutralizer Co., Portland, Maine, with an electric neutralizer to prevent troubles from static electricity.

The Whitin Machine Works, Whitinsville, Mass., have installed a 40-inch revolving flat card, a sliver lapper, one four-head and a six-head ribbon lapper besides a two-head, a six-head and an eight-head comber.

The H. & B. American Machine Works of Pawtucket, R. I., are represented by the following pieces of machinery: — one 40-inch revolving flat card, one two-delivery drawing frame, a roving frame, spinning frame and ring twister.

The Foster Machine Company of Westfield, Mass., has provided two winders for making cones and multiple wound tubes.

There is a two-head comber with a model comber head made by John Hetherington & Sons, Ltd., Manchester, England.

The roving, spinning, and twisting section has the following machinery installed by the Saco-Lowell Shops of Lowell: — two slubbers one of which is for waste spinning, an intermediate, a fine and a Jack frame, also five ring spinning frames, a spinning mule, spooler and a wet and dry twister.

The Fales & Jenks, Pawtucket, R. I., and the Draper Corporation of Hopedale, Mass., have each provided a wet and dry twister; the Whitin Machine Works, three spinning frames, the Woonsocket Machine and Press Company, Woonsocket, R. I., an intermediate fly frame, and the Asa Lees Company, Oldham, England, through their agents, Wm. Firth Company, a fine spinning mule.

Knitting Section. — The winders for this section include a six-spindle Universal winder for cones and tubes and a Payne bobbin winder.

The machines in the following group are equipped with special attachments for producing lace front work, high splicing, double soling and striped work. The hosiery machines include two Acme full automatic, one arranged for 160 needles and the other for 200 needles; also a Mayo Model C full automatic arranged for 220 needles. Scott and Williams have placed in this section four of their machines, Models B–5, KHH and R I. There are three Banner machines, all full automatic, two of which are arranged for 220 needles each and one arranged for 200 needles. There is one Brinton full automatic arranged for 176 needles and one Branson hand machine arranged for 80 needles. For hosiery legs and tops there are 5 ribbers, made by the Wildman Company, with cylinders varying from 3½–5¼ and arranged for needles varying in number from 160–240; 2 Brinton ribbers, one arranged for 176 needles and the other 200 needles; 1 Brinton tie machine, 1¾-inch cylinder 100 needles and 49 needles.

The underwear machinery consists of one Crane spring needle machine, one Scott & Williams ribber, and one Wildman ribber.

Under the group of flat machines there are three Lamb machines, one arranged for knitting gloves and one arranged for knitting sweaters. In addition to these there is also a Grosser sweater machine, a Jacquard machine, and a link and link machine; a Dubied scarf machine; and a Raschel warp knitter.

For finishing work this section includes a Grosser 2-thread looper, one Hepworth looper, two Beattie loopers; 5 Union special sewing machines for over-seaming, double stitch covering, seaming and welting and vest finishing; 6 Merrow sewing machines, including two shell stitch machines and three over-seaming and crocheting machines; 3 Singer machines; 3 Wilcox and Gibbs sewing machines, including a flat lock machine.

The Philadelphia Metal Drying Form Company has installed a table of six forms including men's, women's and children's.

For instruction in the manufacture of braids the New England Butt Company has installed one 24-line Hercules braider, one 12-line braider, one tubular braider, and one soutache braider.

Wool Yarns Department. — For instruction, in wool sorting and grading the room is provided and equipped with benches, baskets, etc., as well as standard samples of all grades of wool which may be used for comparison and examination.

The scouring and carbonizing equipment installed by C. G. Sargent's Sons Corporation consists of one cone duster for grease wool; four scouring bowls arranged in tandem with necessary feeds and modern carrying properties; one single apron dryer, with automatic feeder; one carbonizing screw acid tank and duster, with crush rolls. In this same department the North Chelmsford Machine Company have supplied a rinse box; Schaum & Uhlinger, one hydro-extractor; C. S. Dodge, one shoddy picker and one bagging stand.

Woolen. — In the woolen section there has been installed by the Atlas Manufacturing Company a Parkhurst Burr picker. The Davis and Furber Machine Company have installed a mixing picker equipped with improved mixing picker feed and Spencer oiler, both made by George S. Hardwood & Sons, Boston, Mass. There are three sets of woolen cards furnished by Davis and Furber Machine Company which are equipped with Bramwell feed furnished by George S. Hardwood & Son. One of the sets has the first and second breaker cards coupled. All have apron condensers on the finishers. There is a sample mixing card furnished by the Torrance Manufacturing Company which offers an opportunity for carrying on experiments and mixing various kinds and colors of wool. There are two spinning mules, 120 spindles each, one furnished by the Davis & Furber Machine Company of North Andover and equipped with bobbin holders supplied by the American Bobbin Holder Company, West Medway, Mass., and the other furnished by Johnson & Bassett, Worcester, Mass. In addition to these two mules each company has supplied for the purpose of instruction a spinning mule head mounted on movable platform to facilitate class instruction. Besides these mules the Davis & Furber Machine Company have supplied a fancy yarn twister, 20 spindles; the Lindsay Hyde Company modern skein winder. For Card grinding the B. S. Roy and Son Company of Worcester, Mass., have supplied one grinding frame and two traverse grinders; T. C. Entwistle Co., Lowell, Mass., one traverse grinder; W. H. Brown, Worcester, Mass., one complete set of carder's tools.

Worsted. — In the worsted section the Davis & Furber Machine Company have furnished one double-cylinder worsted card (4 licker-in) with Bramwell feed. On this card as well as one in the woolen section the Chapman Electric Neutralizer Company have supplied one of their patented electric neutralizers. This section also includes a double bowl, 5-cylinder back-washer, with gill box, Taylor-Wadworth & Co., Leeds, Eng., equipped with blueing motion, oiling motion, and Layland patent pressure motion; a weigh gill box and creel and one doubling balling head gill box (with double screws) made by the Saco-Lowell Shops of Lowell, Mass.; a worsted comb with baller punch made by Crompton & Knowles, Worcester, Mass.; two finishing gill boxes, one known as a can gill box and the other a balling head gill box, both made by Hall & Stell, Keighley, Eng.

For the manufacture of yarns under the Bradford System of Drawing, Spinning and Twisting the following machinery as made by Prince Smith & Son, Keighley, Eng., make up the equipment: one revolving creel for 12 balls, one 2-spindle drawing box, one 4-spindle first finisher, one 12-spindle dandy reducer, one 12-spindle cap spinner, one double head can gill box, one 2-spindle gill box, one 2-spindle flyer spinner, one 12-spindle ring spinner, one 12-spindle 2-fold cap twister, one 12-spindle 6-fold ring twister. In addition to this the Saco-Lowell Shops, Lowell, Mass., have installed the following machinery to carry on similar work:

one 2-spindle drawing box, one 6-spindle second finisher, one 24-spindle dandy rover, one 6-spindle cone reducer, one 8-spindle cove rover, one 48-spindle cap spinner, 5-foot end, one 48-spindle cap spinner, 4-foot end, one 48-spindle Boy ring twister. For conditioning yarn C. G. Sargent's Sons Corporation have supplied one of their conditioning machines. The Universal Winding Company have installed one of their 6-gang winders, equipped for cones or straight tubes.

The humidity in the laboratory of the woolen yarns and of the English system of worsted yarns is maintained by the American Moistening Company's system through their automatic control. In this laboratory are installed six humidifiers and four Comins' High Duty heads, which are supplied from an electric driven triplex power pump located in the power house. This same pumping equipment supplies the American Moistening Company's humidifiers operating in the Cotton Yarn Department.

For the manufacture of worsted yarns under the French System of Drawing and Spinning the machinery has been made by the Societe Alsacienne de Constructions Mechaniques, Mulhouse, France, and the equipment consists of the following: Model P. L. B. comb with creel for 24 doublings, intersecting gill box (2 heads), gill box (2 heads), first drawing (2 heads), second drawing (2 heads), third drawing (2 heads), reducer (4 porcupines), slubber (8 porcupines), first intermediate (8 porcupines), second intermediate (8 porcupines), rover (8 porcupines), finisher (16 porcupines), self-acting worsted mule (150 spindles).

The Saco-Lowell shops have recently built and installed a ring spinning frame of 60 spindles for worsted yarns equipped with individual General Electric Company's motor and a Reeves Variable Speed Transmission.

Twelve turbo humidifier heads automatically controlled by a humidity regulator have been furnished by the G. M. Parks Company, Fitchburg, Mass. The compressed air for these heads is supplied by an Ingersoll-Rand 8 by 8 steam-driven air-compressor.

For the purpose of determining the physical properties of fibers, yarns, and fabrics there has been installed a Textile Testing Laboratory where there are the necessary microscopes and micrometers, a skein testing machine, an electric conditioning oven made by the Emerson Apparatus Company of Boston; single yarn and fabric strength testing machines made by G. R. Smith & Co., Bradford, England; a strength testing machine, capacity 500 kilograms, for testing twines and fabrics; a fiber testing machine for testing fibers and fine yarns with capacity, 1 gram to 1.5 kilograms; a yarn strength testing machine with capacity, 1,000 to 5,000 grams; and a yarn strength testing machine with capacity, 5 to 30 kilograms, all of which have been made by Louis Schopper, Leipzig, Germany. Besides these we have a standard yarn and fabric testing machine as made by Henry L. Scott & Company of Providence, R. I., and a Mullen Tester. For the automatic control of temperature and humidity there has been installed by the American Moistening Company of Boston one of their automatic humidity and temperature regulators.

Design and Power Weaving Department. — In the fabric analysis section there has been provided chemical balances made by Voland & Sons and Christian Becker, necessary twist testers, microscopes, reels, etc., as well as a Torsion calculation balance made by the Torsion Balance Company of New York.

In the warp preparation department there has been installed by the Saco-Lowell Shops one of their spoolers besides a warper and a slasher for preparing cotton warps; a beamer by T. C. Entwistle Company of Lowell, a 400-end improved Draper warper furnished by the Draper Corporation of Hopedale, Mass. The Whitin Machine Company, Whitinsville, Mass., have supplied a 180-spindle, long-chain quiller, and the Johnson & Bassett Company, Worcester, Mass., a quiller of their make. The Universal Winder Company has supplied a winder for copy and bobbin winding and an 8-spindle doubler.

The woolen and worsted warp preparation department contains two 40-end Jack spoolers, two spool racks for 12 spools each, one pattern dry frame dresser, one pipe and cylinder dresser, one 60-inch reel, one 82-inch reel, and one double head beamer, all supplied by the Davis & Furber Machine Company of North Andover, Mass.

The Weaving Department contains four looms supplied by the Draper Cor-

poration of Hopedale, Mass., which include a plain Northrup, an 8-harness corduroy, an improved Northrup, a Northrup with dobby. The Stafford Loom Company of Readville, Mass., has installed one plain, one cam, one dobby loom and one broad sheeting loom, all equipped with individual motors; the Whitin Machine Works, Whitinsville, Mass., a side cam twill, a plain print cloth loom, equipped with Kip-Armstrong electric warp stop motion; the Kilburn and Lincoln a plain loom; Lewiston Machine Company a 4-harness side cam and a bag loom; Crompton and Knowles Loom Works a jean loom and a plain loom with individual drive. Four of these looms are equipped with Abbott cleavers made by the Abbott Wire and Cast Steel Warp Cleaving Company, Lisbon Falls, Me. The Hopedale Manufacturing Company of Milford, Mass., has recently installed one of its high speed looms with individual motor.

The fancy loom section includes a Stafford Ideal 16-harness automatic shuttle-changing loom, a Whitin 20-harness dobby loom and the following furnished by the Crompton-Knowles Loom Works: — Knowles gingham 4 by 1 boxes, Crompton gingham 4 by 1 boxes, one Crompton towel 2 by 1 boxes, two Terry towel and one huck towel looms, a 16-harness lappet loom, a 20-harness dobby 4 by 1 boxes, fancy leno loom, and a Crompton fancy cotton single cylinder 20-harness dobby.

The woolen and worsted section contains a Knowles 20-harness Gem, a Crompton 24-harness worsted 4 by 4 boxes, a Crompton 6 by 1 double cylinder 20-harness dobby, one heavy 20-harness 4 by 4 boxes, one 20-harness and one 25-harness blanket, seven intermediate woolen 25-harness 4 by 4 boxes and two 90-inch 25-harness heavy woolen looms.

The Jacquard loom section includes one Stafford silk loom, 1,200-hook, Halton head; one 400-hook, single-lift, Schaum & Uhlinger Jacquard, mounted for 4-bank, narrow fabric loom; one Felix Tonnar German plush loom, with 400-hook Crompton & Knowles Jacquard head; one Skinner Brussels carpet loom, three-quarters wide, equipped with 1,280-hook Jacquard head presented by the Bigelow-Hartford Carpet Company, Clinton, Mass. The Crompton & Knowles Loom Works have furnished one Knowles fancy loom, single-lift Jacquard; one Knowles fancy loom, double-lift Jacquard; one Knowles fancy loom, Jacquard tied up for leno, one Knowles ingrain carpet loom, 4 by 4 boxes, one Knowles loom, 4 by 4 boxes, 54-inch, with 600-hook, double-lift, double-cylinder McMurdo Jacquard head, tied up for damask napkin designs, one Crompton ingrain carpet loom, 4 by 4 boxes, one Crompton & Knowles 72-inch tapestry loom, with 2,600-hook Halton Jacquard head, one 840-hook, double-lift, single-cylinder Jacquard on Crompton & Knowles 4-bank ribbon loom, one 800-hook, double-lift Knowles Gem silk brocade Jacquard machine, 4 by 4 boxes.

For the purpose of card cutting there has been furnished one Jacquard fine index card-cutting machine by John Royle & Sons, Paterson, N. J.; one Jacquard French index card-cutting machine by the same concern and one Jacquard French index card-cutting machine, presented by the Bigelow-Hartford Carpet Company, Lowell, Mass.

Chemistry and Dyeing Department. — The Chemistry laboratories consist of one to give instruction in General Chemistry and Qualitative Analysis and provides facilities to take 120 students. The Quantitative Laboratory takes care of some 50 students and contains the necessary drying closet, steam bath, electrolytic table, with ample facilities to provide distilled water through the use of a Barnstead Water Still. The Balance Room, which is adjacent to the laboratory, has eleven analytical balances made by such concerns as Christian Becker, Eimer & Amend, and H. L. Becker's Sons & Co. The Organic Laboratory has facilities to take care of approximately 25 students having the necessary equipment required in the preparation of basis organic compounds and instruments used in the manufacture of dyes such as autoclaves, electric and gas combustion furnaces.

For the purpose of carrying on photographic and microscopic experiments and analyses the laboratory has been provided with equipment which includes besides the Bausch & Lomb microscopes, a polariscope made by Franz Schmidt & Haensch, Berlin, Germany, a Gaestner spectroscope, a Bausch & Lomb Model G photomicrographic apparatus equipped with D. D. S. microscope and all necessary apparatus, a Kodak projection printer. In the dark room there has been placed a piece of apparatus for determining the relative fading powers of various light

sources. Besides the common gas and electric lamps there is installed a solar determinator, made by the Atlas Electric Company, Chicago, Ill., also a 400-watt Nela Trutint and color matching unit made by Nela Specialties Division, Cleveland, Ohio.

The Chemical Museum has been provided with cases and representative dyestuffs all furnished by various dyestuff manufacturers of this country and abroad. This offers an unparalled opportunity for students to study and experiment with almost all of the representatives dyes which are used in the textile industry.

The Experimental Dyeing Laboratory is equipped with individual benches, small dyeing apparatus, reels, balances, apparatus for dye testing, such as frames for exposing dyed material to light, and a complete collection of dyestuff samples and sample cards. There are also fifty-six steam coil experimental dyeing baths, a drying chamber and aging chamber, in addition to a Hurricane Dryer, Class D, made by the Philadelphia Drying Machinery Company, Pennsylvania. Adjacent to the Experimental Dyeing Laboratory there has been provided a well-lighted room for the storage of a great variety of dyestuffs. Steel shelving has been arranged so that the samples are easy of access. All samples are catalogued in a card file, thus facilitating their use. In this same room are provided a sink and cement table with balances.

The Experimental Printing Laboratory is equipped with a calico printing machine, made by Mather & Platt, Manchester, Eng., an iron jacketed steaming chamber from A. Edmeston & Son, Patricroft, Eng., and a set of steam jacketed copper kettles.

The Fuel and Oil Analysis Laboratory contains the following equipment for the analysis of coals and fuels: a Mather bomb calorimeter, with complete outfit, an Emerson bomb calorimeter, with complete outfit, a Parr calorimeter, an Abbe refractometer, a Torsion viscosimeter, a Tagliabue viscosimeter, a Tagliabue cold test apparatus, a Pensky Martin oil tester, a New York State oil tester, a Sartorius specific gravity balance, two Becker analytical balances, gas muffle furnace, Kny-Scherer oil tester, a Graefe gas calorimeter, an Orsat gas analysis apparatus, laboratory tables, lockers, and hoods.

The Industrial Chemistry Laboratory contains the following: one filter press, Type E. T. Shriver & Co., a single-acting triplex plunger pump, Goulds Manufacturing Company, a vacuum drying apparatus, a surface condenser, a Packard vacuum pump, Norman Hubbard's Sons, a vacuum evaporator, Swenson system, American Foundry and Machine Company, a centrifugal, C. H. Chavant & Co., a double jar mill, F. I. Stokes & Co.

For the purpose of carrying on dyeing on a basis which is more comparable with commercial practice there is provided a laboratory which includes the following equipment: a small kier, fitted with E. D. Jefferson's circulating device, an electrolyzer for manufacturing bleaching solutions, the National Laundry Machine Company, Dayton, Ohio, a Permutit filter, the Permutit Company, New York City, a mercerizing machine, a raw stock dyeing machine, Klauder-Weldon Dyeing Machine Company, Yardley, Pa., a yarn dyeing machine, Klauder-Weldon Dyeing Machine Company, a jig dyeing machine, the Textile-Finishing Machine Company, Providence, R. I., a set of drying cans by the same concern, a chain dyeing machine, T. C. Entwistle Company, Lowell, Mass., a raw stock drying table, Proctor & Schwartz, Philadelphia, Pa., a padding mangle, Arlington Machine Works, Arlington, Mass., a hydro-extractor, W. H. Tolhurst & Son, Troy, N. Y., a Psarski experimental dyeing machine, a Hussong experimental dyeing machine, equipped for raw stock or yarns, a Rodney Hunt sample piece dyeing machine, equipped with an automatic temperature and pressure-regulating apparatus, made by C. J. Tagliabue Manufacturing Company, Brooklyn, N. Y. The Franklin Process Company, Providence, R. I., have furnished a 25-pound bronze dyeing machine. Of the various dye tubs, one is equipped with a Monel Metal lining to withstand the action of various chemicals and dyes.

Finishing Department. — The Woolen and Worsted section includes a 4-string washer, a fulling mill, and a combination fulling and washing mill for jersey fabrics, furnished by the Rodney Hunt Company, Orange, Mass.; a sample fulling mill, a kicker mill, furnished by James Hunter & Co., North Adams, Mass.; an up and down dry gig, a rolling and stretching machine, an up and down wet gig,

a steam finishing machine, a 60-inch, 3-burner singeing machine, adapted for cotton, silk or worsted goods, a 2-cylinder double-acting brushing machine, a 60-inch, 4-cylinder sanding and polishing machine, furnished by Curtis & Marble, Worcester, Mass.; a 6/4 double shear, an A. W. C. measuring and weighing machine, furnished by Parks & Woolson, Springfeld, Vt.; a dewing machine, a 6/4 Voelker rotary press, furnished by G. W. Voelker & Co., Woonsocket, R. I.; a single shear, Curtis & Marble, donated by Massachusetts Mohair Plush Company, Lowell, Mass.; a tentering and drying machine furnished by John Heathcote, Providence, R. I., a single crabbing machine, H. W. Butterworth & Son, Philadelphia, Pa.; a 72-inch woolen napper donated by Davis & Furber, North Andover, Mass.; a 32-inch basket hydroextractor, W. H. Tolhurst, Troy, N. Y.; a Lintz & Eckhardt cloth numbering machine, improved by Durbrow & Hearne Manufacturing Company, New York; a steam press for underwear, United States Hoffman Company, Syracuse, N. Y.; a sewing machine, Birch Brothers, Somerville, Mass.

The Cotton section includes a 40-inch inspecting and brushing machine, a 44-inch No. 25 railway sewing and rolling machine, a 44-inch cotton shearing machine, Type No. 34, a 44-inch No. 3 steam calender rolling machine, a 40-inch cloth folder, a 40-inch winder and measurer, a set 44-inch shear blades for grinding purposes, furnished by Curtis & Marble, Worcester, Mass.; a 48-inch No. 4 opening, sewing and re-rolling machine, a No. 1 hand power portable railway sewing machine, furnished by Dinsmore Manufacturing Company, Salem, Mass.; a 40-inch 4-tank open soaping machine equipped with patent flushing rolls, brass and rubber squeeze rolls and spiral openers, furnished by Birch Brothers, Somerville, Mass.; an 84-inch 36-roll, ball bearing, double acting napper, equipped with a 7½-horsepower General Electric motor drive, furnished by Davis & Furber, North Andover, Mass. (the ball bearings were donated by the Farnir Bearing Company, New Britain, Conn.); an 8-inch belt lacer furnished by the Clipper Belt Lacer Company of Grand Rapids, Mich.; a 40-inch, 3-roll water mangle, with husk and brass rolls and usual attachments and equipped with a 48-inch Mycock scutcher, and a 40-inch Mycock cloth expander made by Thomas Leyland & Co., Boston, a 40-inch, 2-roll starch mangle, a 40-inch upright drying machine with 10 copper cylinders equipped with Files dry can system, Files Engineering Company, Inc., Bridgeport, Conn., a 40-inch sprinkler, a 40-inch, 5-roll Universal calender with chasing attachment and equipped with a 40-inch Mycock cloth expander, a pasting table with plate, furnished by the Textile-Finishing Machinery Company, Providence, R. I.; a 16 by 24 inch bronze-covered stretcher for the drying cans, C. A. Luther & Co., Providence, R. I.; a 40-inch double bristle stretcher for drying cans, American Finishing Machinery Company, Boston, Mass.; a 40-inch Tommy Dodd starch mangle, H. W. Butterworth & Sons Company, Philadelphia, Pa., and a 44-inch, 50 foot vibratory tentering machine. This machine is directly driven by a 7½-horsepower variable speed motor and is equipped with a Schwartz automatic electric guider, made by L. H. A. Schwartz & Co., Boston, Mass.

Engineering Department. — The Steam Engineering Laboratory contains the following equipment arranged for experimental purposes: A 50-horsepower Allis-Chalmers Corliss steam engine direct connected to an Alden absorption dynamometer, and piped to exhaust its steam to the atmosphere, to a Wheeler surface condenser or to the Kerr turbine; a Kerr seven-stage turbine driving directly a 25-kilowatt Richmond Electric Company's alternating current generator and piped to exhaust either to the atmosphere or the condenser. It may be operated either as high pressure or low pressure turbine, and the generator has special connections to illustrate various commercial phases. In addition there are a 4 by 6 Deane triplex power pump, two 2-inch centrifugal pumps made by Lawrence Machine Company, Lawrence, Mass., a Clayton air compressor and necessary tanks, scales and measuring instruments. For the measurement of flow of air there are a steam driven Sturtevant fan and a motor-driven Massachusetts fan with heater combined for heating and drying experiments.

For instruction in leveling and surveying there are provided three engineer's transits, leveling rods, etc.

The Electrical Engineering Laboratory consists of two sections, one of which is devoted to instruction in the generation and transmission of power, and contains the necessary switchboard and instruments to control a 25-kilowatt alternating

current turbo generator and a 15-kilowatt motor generator set arranged to supply either direct or alternating current. In addition there are a 24-horsepower direct current Allis-Chalmers motor and a 10-horsepower direct current General Electric motor, also a 10 and a 7.5 horsepower General Electric alternating current motors besides a General Electric 3-kilowatt rotary transformer and three Westinghouse stationary transformers. The other section of the laboratory is known as the instrument laboratory and is for the purpose of giving instruction in the measurement of current voltage, resistance and in the calibration of instruments. It contains a 5-kilowatt Crocker-Wheeler balancer, a 160-ampere hour storage battery, a 5-kilowatt 220-volt to 440-volt General Electric transformer, a Westinghouse portable wattmeter with current and potential transformers, three wattmeters, two ammeters and a voltmeter, all of the General Electric portable alternating current type, a 30-volt alternating current Roller Smith voltmeter, a 5 to 10-scale Weston ammeter (electro dynamometer type), a Weston millivoltmeter with 2, 20, 50 and 200 ampere shunts, three 250-volt direct current Weston voltmeters, a 150-ampere, two model 45, two model 260 Weston portable ammeters, a Weston model 260 voltmeter, a Thompson 50-ampere recording wattmeter, a General Electric rotating standard wattmeter, two General Electric induction type watt hour meters, an Esterline portable curve drawing wattmeter, a 100-ampere Leeds & Northrup Standard Resistance, a Leeds & Northrup Ayrton shunt, a Weston laboratory standard voltmeter with 600-volt multiplier, a Leeds & Northrup potentiometer, a D'Arsonval wall type galvanometer, a Wheatstone bridge with galvanometer, a slide wire bridge, and electrodynamometer, Weston Standard cell, potential phase shifter, a standard Leeds & Northrup photometer with Lummer-Brodhun screen, and Macbeth illuminometer made by the same concern.

Machine Shop. — The equipment of the machine shop is as follows: Four standard engine lathes, 13-inch swing, 6-foot bed, from Flather & Co., Nashua, N. H.; three standard engine lathes, 14-inch swing, 6-foot bed, from Flather & Co., Nashua, N. H.; a standard engine lathe, 15-inch swing, 6-foot bed, from F. E. Reed Company, Worcester, Mass.; an engine lathe, 18-inch swing, 10-foot bed, from Flather & Co., Nashua, N. H.; an engine lathe, 18-inch swing, 6-foot bed, from Champion Tool Works, Cincinnati, Ohio; a standard engine lathe, 15-inch swing, 6-foot bed, from S. H. Putnam Sons, Fitchburg, Mass.; five speed lathes, 17-inch swing, 5-foot bed, from J. G. Blount, Everett, Mass.; one No. 1 Universal milling machine, with all three feeds automatic, from Kempsmith Manufacturing Company, Milwaukee, Wis.; one 24 by 24 inch, 6-foot planer, from the Mark Flather Planer Company, Nashua, N. H.; one 23-inch upright drill, with back gears and power feed, from J. E. Snyder & Son, Worcester, Mass.; one 14-inch single sensitive drill, from the Stanley Manufacturing Company, Lawrence, Mass.; one No. 1 Universal grinder, from Landis Tool Company, Waynesboro, Pa.; one 20-inch wet tool grinder, from J. G. Blount, Everett, Mass.; one 12-inch, 2-wheel dry grinder, from J. G. Blount, Everett, Mass.; an American twist drill grinder, from the Heald Machine Company, Worcester, Mass.; one Type 1B portable electric grinder from the Cincinnati Electric Tool Company, Cincinnati, Ohio; one 30-inch grindstone and frame, from the Athol Machine Company, Athol, Mass.; a single spindle centering machine, from D. E. Whiton Machine Company, New London, Conn.; one 15-inch shaper, from Potter & Johnson, Pawtucket, R. I.; one power hacksaw, from the Fairbanks Company, Boston, Mass.; one cold saw, from John T. Burr & Son, Brooklyn, N. Y.; one Eureka metal power saw, Manning, Maxwell & Moore; one Type CC electric drill, Cincinnati Electric Tool Company; one Universal milling attachment for Kempsmith milling machine, Taylor Machinery Company; one Hisey Type B ½-horsepower tool post grinder, Taylor Machinery Company; one No. 2 Cory bench straightener, Manning, Maxwell & Moore; one No. 3 Universal cutter and reamer grinding machine, Browne and Sharpe; a well-equipped tool room containing a selected stock of the best makes of small tools, such as drills, taps and dies, milling cutters, reamers, gauges, micrometers, etc.

Power, Light, Heat and Ventilating Plant. — In the new power house, completed in 1913, there is located the main power-generating apparatus for supplying light, heat and power to all departments of the school. The equipment here consists of: two 250-horsepower Heine water tube boilers, equipped with Perfection grates, a 300-horsepower Aultman & Taylor horizontal water tube boiler, equipped

with United States rocking grates, two boiler feed pumps — one a Knowles and the other a Deane — a 40,000-pound Cochrane metering open-feed heater, which is provided with a Lea recorder, and a Cochrane oil extractor heats and measures all feed water, a 3-inch Venturi meter in feed line with indicating manometer as made by the Builders Iron Foundry, Providence, R. I. In the Engine Room are located: a Payne 14 by 14 automatic high speed engine, 125-horsepower direct connected to 75-kilowatt, 220-volt, direct-current Bullock generator, a 9½ by 11 Nash gas engine of 50-horsepower, 4-cycle type, with speed-regulating clutch and a "hit and miss" governor, direct connected to a 30-kilowatt, 220-volt, direct-current Bullock generator, a 65-kilowatt motor generator set, consisting of a direct current motor and an alternating current generator. This unit may be run either A. C. to D. C. or D. C. to A. C., and was made by the Westinghouse Electric and Manufacturing Company. A steam-driven Ingersoll-Rand 8 by 8 air compressor, for use with Turbo heads, installed in the French Spinning Department by the G. M. Parks Company, Fitchburg, Mass., a 5½ to 6 motor-driven air compressor, with 20 cubic foot storage tank for use in starting Nash gas engine, a Cross oil filter. The station switchboard is of marine-finished slate, 90 inches in height, and consists of three generator panels and two circuit panels.

The power house is connected with the main school buildings by a tunnel through which all wires, steam and water pipes are carried. The steam pipes supply heat to the buildings by means of direct radiation, and by means of the Sturtevant double duct heating and ventilating system located in the basement of Southwick Hall, and by the Sturtevant fan and heater located in the basement of Kitson Hall. Direct-driven exhaust fans are placed on the roof of Southwick Hall and in the basement laboratories.

ALUMNI ASSOCIATION.

The Alumni Association of the School holds its annual meeting and banquet in May of each year in Lowell, Mass.

The membership of the association is restricted to graduates of the day school. Honorary membership is open to the Board of Trustees, the faculty and such others as may be elected by the association.

Officers for the Year 1926-27.

Herbert A. Currier, '06, *President.*
Harold W. Conant, '09, *Vice-President.*
Arthur A. Stewart, '00, *Secretary-Treasurer.*

Communications should be addressed to Arthur A. Stewart, Lowell Textile School.

Alumni Trustees.

Edward M. Abbot, '04
Edward A. Bigelow, '06
Henry A. Bodwell, '00
Thomas T. Clark, '10
William R. Moorhouse, '01
T. Ellis Ramsdell, '02
Royal P. White, '04

Executive Committee.

15 Members.

Philip H. Warren, '05, *Chairman*
James F. Dewey, '04
Leonard S. Farr, '08
Russell T. Fisher, '14
Harold B. Frost, '12
Olin D. Gay, '08
Arthur J. Hennigan, '06
Parker W. Longbottom, '21
Brackett Parsons, '20
Everett B. Rich, '11
Irving N. Stronach, '10
Ernest D. Walen, '14
J. Milton Washburn, '21
A. Edwin Wells, '20
Stanley H. Wheelock, '05

Note.—Officers and Alumni Trustees are *ex-officio* members of Executive Committee.

GRADUATES, JUNE 8, 1926

Graduates, with Titles of Theses

Bachelor of Textile Engineering

Franz Evron Baker, Winchendon, Mass. "The Development of a Device for Producing a Novelty Yarn." (With Thomas Joy).

Harold Thomas Godfrey, North Andover, Mass. "A Study of the Proper Tensions for Applying Various Types of Fillet Card Clothing."

Thomas Joy, Lowell, Mass. Thesis with Franz E. Baker.

Francis Charles Kennedy, Holyoke, Mass. "An Investigation to Establish a Practical Commercial Standard for the Strength and Elasticity of Two-and Three-Ply Yarns."

Limao Kuo, Taichowfu, China. "Experiments on Long Spinning Draft and the Use of Mechanical Devices to Condense the Fibres in Cotton Spinning."

Ehrich Ernest Max Schreiter, Walpole, Mass. "Design of a Device to Measure the Tension in a Yarn During Spinning, and a Study of the Effect of the Weight of the Traveler upon Yarn Tension."

Bachelor of Textile Chemistry.

Norman Spaulding Buchan, Andover, Mass. "The Mechanism of the Carbonizing Reaction."

Theodore Charles Coté, Groveland, Mass. "Some New Vat Dyes of the Anthraquinone Series."

Philip Edwin Mason, Melrose Highlands, Mass. "The Improvement of the Dyeing Properties of Rayon."

Samuel Mazer, Roxbury, Mass. Part I — "The Preliminary Treatments and Coloring of Silks." Part II — "A Study of the Fastness to Light and Washing of Dischargeable Colors for Dyeing Grounds on Silk."

William Charles Smith, Chadwicks, N. Y. "The Relative Evaluation of Desizing Agents and Kier Boiling Compounds Used in Preliminary Treatment of Cotton Cloth." (With Fred W. Sturtevant).

Fred William Sturtevant, Lowell, Mass. Thesis with William C. Smith.

Diploma Graduates.

Cotton Manufacture.

William Samuel Baker, Lowell, Mass. "The Construction of a Mercerized Cotton Shirting."

Alfred Francis Slamin, Wellesley, Mass. "The Construction of a Fancy Rayon Shirting."

Allen Batterman Smith, Winchester, Mass. "The Construction of a Ladies' Cotton Dress Goods."

Harry LeRoy Swain, Jr., Kent, Ohio. "The Construction of a Fancy Rayon Dress Goods."

Wool Manufacture.

Harold Robert Anderson, Lowell, Mass. "The Manufacture of a Men's Wear Serge."

Byron Bentley, Methuen, Mass. "The Manufacture of a Light Weight Woolen Overcoating."

John Joseph Callahan, Jr., Somerville, Mass. "The Manufacture of a Fancy Cassimere."

Ernest Dana Gilman, Methuen, Mass. "The Manufacture of an Unfinished Worsted Suiting."

William Tabor Hathaway, Cambridge, Mass. "The Manufacture of a Close Finish Worsted Suiting."

George Franklin Isaacson, Waltham, Mass. "The Manufacture of a Fancy Worsted Suiting."

GEORGE HERBERT LEAVITT, Lowell, Mass. "The Manufacture of a Fancy Woolen Suiting."

LESLIE CAPRON REDDING, Woonsocket, R. I. "The Manufacture of a Fancy Cassimere."

CHARLES BAIRD TEAGUE, Somerville, Mass. "The Manufacture of a Men's Wear Serge."

MAURICE ARTHUR VILLENEUVE, Dorchester, Mass. "The Manufacture of a Worsted Cheviot Suiting."

Textile Design.

WILLIAM HENRY VINCENT, Hyde Park, Mass.

Prizes awarded in June 1926.

The Medal of the National Association of Cotton Manufacturers awarded to the student taking course in Cotton who maintains the highest average in scholarship throughout this course. To *Limao Kuo.*

Saco-Lowell Prize of $100 for thesis prepared for graduation which will be considered of greatest value to the textile industry. To *Francis Charles Kennedy* and *Ehrich Ernest Schreiter.*

Edward A. Bigelow Prize of $100 to the member of the graduating class from the Wool Manufacturing course who maintains the highest standing throughout his three years. To *George Herbert Leavitt.*

Edward A. Bigelow Prize of $50 to the member of the second year class in the Wool Manufacturing course who maintains the highest standing during his second year. To *Edwin Thomas Hanscom.*

Edward A. Bigelow Prize of $25 to the member of the first year class in the Wool Manufacturing course who maintains the highest standing during his first year. To *Walter Urban Gaudet.*

Louis A. Olney Prizes (in the form of books).

$10 to the regular student of the Chemistry and Textile Coloring course who shall be considered as having attained the highest scholarship during his second year. To *John Vincent Killheffer.*

$5 to the regular student of the Chemistry and Textile Coloring course who shall be considered as having attained the second highest scholarship during his second year. To *Paul Leon Fasig.* Honorable Mention, *Walter Coburn Lindsly.*

$10 to the student taking the regular Chemistry and Textile Cororing course who shall be considered as having attained the highest scholarship in first-year Chemistry. To *Amos Kempton Haynes.*

$5 to the student taking the regular Chemistry and Textile Coloring course who shall be considered as having attained the second highest scholarship in first-year Chemistry. To *Alvin Wilfred Bergeron.* Honorable Mention, *Earle Raymond McLean.*

Herbert A. Currier Scholarship. — $100 given by Herbert A. Currier of the Class of 1906 to a student selected by the faculty of the school, the following conditions to be considered in making the selection: scholastic standing, financial need, and ability in promoting student activities in school life. To *Daniel Joseph Coffey.*

REGISTER OF DAY STUDENTS.

Candidates for Degree.

Class of 1927.

Name, Home Address	*Lowell Address*
Brosnan, William Francis, IV, Lowell, Mass.	38 Second Avenue
Farley, Clifford Albert, VI, Lowell, Mass.	215 Princeton Street
Flood, Thomas Henry, IV, Lowell, Mass.	49 Madison Street
Flynn, Thomas Joseph, IV, Pittsfield, Mass.	Delta Kappa Phi House
Ford, Stephen Kenneth, IV, Haverhill, Mass.	———
Franks, Jerome, VI, Brooklyn, N. Y.	106 Crawford Street
Glickman, Bernhardt, IV, Dorchester, Mass.	———
Goldenberg, Louis, VI, Boston, Mass.	17 Edson Street
Guild, Lawrence Winfield, VI, Quincy, Mass.	Phi Psi House
Hooper, Clarence, IV, Shirley, Mass.	———
McKay, Benedict Josephus, IV, Stoughton, Mass.	142 Riverside Street
McKinnon, Norman, VI, Lowell, Mass.	179 Princeton Street
Meeker, Samuel, IV, Lowell, Mass.	295 Foster Street
Merrill, John Leslie, VI, Lowell, Mass.	96 Dingwell Street
Meyers, Chester William, IV, Billerica, Mass.	———
Parkin, Robert Wilson, VI, Maynard, Mass.	20 Hurd Street
Parsons, Charles Sumner, VI, East Milton, Mass.	793 Merrimack Street
Sawyer, Richard Morey, VI, Winchester, Mass.	Omicron Pi House
Shea, John Francis, IV, Fitchburg, Mass.	Delta Kappa Phi House
Tarpey, Thomas Joseph, IV, Somerville, Mass.	Delta Kappa Phi House
Woodbury, Kenneth Leroy, VI, Bradford, Mass.	———

Class of 1928.

Anderson, Harry Eric, VI, Lowell, Mass.	39 Daniels Street
Birdsall, Edgar Wallace, IV, Southbridge, Mass.	Omicron Pi House
Burns, Robert, IV, Easthampton, Mass.	Phi Psi House
Corbett, James Francis, IV, Dracut, Mass.	———
Fasig, Paul Leon, IV, Reading, Pa.	125 Mt. Washington Street
Fitzgerald, John Francis, IV, Lawrence, Mass.	———
Goddard, Langdon Warren, VI, Concord Junction, Mass.	142 Riverside Street
Gottschalck, Lawrence, VI, Gloversville, N. Y.	Omicron Pi House
Holbrook, Ralph Wentworth, IV, Allston, Mass.	141 Pawtucket Street
Killheffer, John Vincent, IV, North Caldwell, N. J.	Phi Psi House
Konieczny, Henry, IV, Dracut, Mass.	———
Lindsly, Walter Coburn, IV, Lowell, Mass.	49 Nesmith Street
Logan, George Leslie, VI, South Portland, Me.	Phi Psi House
McGuire, Edward Perkins, VI, Chestnut Hill, Mass.	14 Mt. Washington St.
McKittrick, Raymond Wellington, VI, Lowell, Mass.	15 Hawthorne St.
Osborne, George Gordon, VI, Washington, Conn.	256 Branch Street
Parigian, Harold Hrant, IV, Hudson, Mass.	769 Merrimack Street
Reinhold, Kurt Herman, VI, Clifton, N. J.	Phi Psi House
Rodalvicz, Francis Rudolph, IV, Anthony, R. I.	Delta Kappa Phi House
Russell, William Samuel, Jr., VI., Haverhill, Mass.	———
Sampson, Clifford William, IV, Plymouth, Mass.	Phi Psi House
Slack, John Taylor, 2nd, VI, Springfield, Vt.	Phi Psi House
Storey, Alvin Briggs, VI, Lowell, Mass.	272 Merrimack Street
Tanguay, Gerard, IV, Lowell, Mass.	256 Branch Street
Tarshis, Elias Aaron, IV, Springfield, Mass.	227 Pawtucket Street
Ward, George Chester, IV, Andover, Mass.	———
Warren, Eva Maybelle, IV, Billerica, Mass.	———
Westaway, John Chester, VI, Hamilton, Ont.	Phi Psi House
Wingate, Edward Lawrence, Jr., VI, Malden, Mass.	Omicron Pi House

Class of 1929.

Anderson, Alfred Ballard, VI, Framingham, Mass.	272 Merrimack Street
Balch, Ralph Herman, VI, Billerica, Mass.	———
Beardsell, Arthur Herrick, VI, Concord, Mass.	Omicron Pi House
Bergeron, Alvin Wilfred, IV, Haverhill, Mass.	———
Buzzell, Harry Saville, VI, Lowell, Mass.	30 Highland Avenue
Ellis, James Oliver, VI, Chelmsford, Mass.	———
Fairweather, John Ross, VI, Jackson Heights, N. Y.	Omicron Pi House
Folsom, Edward Ellsworth, VI, Swampscott, Mass.	272 Merrimack Street
Fredrickson, Charles Joseph, Jr., IV, Shawsheen Village, Mass.	———
Hale, Everett Lane, VI, Stoneham, Mass.	———
Haynes, Amos Kempton, IV, Haverhill, Mass.	———
Hetherman, Patrick Joseph, IV, Lowell, Mass.	306 School Street
Holt, Lawrence Currier, VI, Lexington, Mass.	43 Plymouth Street
Howorth, Harmon, VI, Nashua, N. H.	71 Harris Avenue
Hurd, Ira Swain, IV, Haverhill, Mass.	Omicron Pi House
Hyun, Chirl, VI, Kai Chun, Korea	272 Merrimack Street
Johnstone, Edwin Parker, Jr., IV, New Haven, Conn.	51 Sixth Avenue
Larter, Edward Alan, VI, Suncook, N. H.	Omicron Pi House
McGibbon, James Greig, IV, Lexington, Mass.	143 Riverside Street
McIntosh, William Petrie, Jr., IV, Haverhill, Mass.	272 Merrimack Street
McLean, Earle Raymond, IV, Haverhill, Mass.	Delta Kappa Phi House
Matthews, Robert Jackson, VI, Gardner, Mass.	11 White Street
Murphy, Sylvester, IV, Allerton, Mass.	Phi Psi House
Myers, Walter Flemings, VI, Lowell, Mass.	21 Albert Street
Phelan, Bernard Michael, IV, Ipswich, Mass.	Delta Kappa Phi House
Rice, Kenneth Earl, VI, Stoneham, Mass.	———
Robbins, Walter Archibald, VI, Lowell, Mass.	146 Hampshire Street
Ryberg, Bertil August, IV, Centerville, Mass.	272 Merrimack Street
Shelton, Charles Leopold, VI, Jamaica Plain, Mass.	———
Simmons, Osborne Arthur, VI, Lowell, Mass.	3 Branch Avenue
Stacey, Alfred Charles, IV, Andover, Mass.	———
Stanley, John Prince, Jr., IV, Lewiston, Me.	272 Merrimack Street
Stewart, John Weeden, IV, Brattleboro, Vt.	128 Mount Washington St.
Westbrooke, Clayton Collington, IV, North Andover, Mass.	———
Wiech, Raymond Edward, IV, Lowell, Mass.	423 High Street
Zalkind, Benjamin Joseph, VI, Dorchester, Mass.	———

Class of 1930.

Anthony, Louis Lowell, IV, Lowell, Mass.	20 Loring Street
Barsky, Morris, IV, Brooklyn, N. Y.	227 Pawtucket Street
Bates, John Alden, IV, Bradford, Mass.	———
Beeman, Earl Royal, VI, Quincy, Mass.	137 Riverside Street
Blessington, John James, VI, Lowell, Mass.	53 Second Avenue
Brosnan, James Henry, IV, Lowell, Mass.	100 White Street
Cappabianca, Libero Frank, IV, Haverhill, Mass.	———
Carbone, Alfred John, IV, Haverhill, Mass.	———
Casey, Francis Harold, IV, Roslindale, Mass.	———
Cleveland, Richard Sumner, VI, Pepperell, Mass.	———
Colby, Willard Alvah, Jr., IV, Haverhill, Mass.	———
Davidson, Nathan, IV, Dorchester, Mass.	———
Dunlap, Kirke Harold, Jr., VI, Lowell, Mass.	72 Fort Hill Avenue
Edwards, Elizabeth Erma, A. B., IV, Centralia, Ill.	137 Riverside Street
French, Wallace Howe, IV, Lowell, Mass.	636 Rogers Street
Gallagher, Arthur Francis, IV, Lowell, Mass.	36 Merrill Street
Greendonner, George John, IV, Stafford Springs, Conn.	Nashua, N. H., R. F. D.
Gross, Herman, IV, Newark, N. J.	142 Riverside Street
Hetherman, John Michael, IV, Lowell, Mass.	306 School Street

Johnson, Russell, IV, West Medford, Mass.	———
Jones, Bliss Morris, IV, Lexington, Mass.	43 Plymouth Street
Kelly, Julian Thurber, VI, New Britain, Conn.	142 Riverside Street
Kolsky, Samuel Irving, IV, Lawrence, Mass.	———
Kostopoulos, Emanuel Arthur, VI, Lowell, Mass.	270 Adams Street
Krishan, Maharaj, VI, Montgomery, India	137 Riverside Street
Livingstone, Bernard, IV, Woodstock, Vt.	272 Merrimack Street
McCaffrey, Francis Matthew, VI, Lowell, Mass.	14 Dunfey Street
McDonald, Gerald Francis, IV, Lowell, Mass.	208 Mount Hope Street
McGee, Francis Patrick, IV, Lowell, Mass.	94 Beacon Street
Meady, Benjamin Balch, IV, Lexington, Mass.	———
Nelson, Edward James, IV Haverhill, Mass.	———
Orlauski, Anthony, IV, Haverhill, Mass.	———
Preston, Harold Lawrence, VI, Wakefield, Mass.	———
Rand, Ralph Frederick, VI, Lowell, Mass.	495 Central Street
Ray, Lloyd Sanford, IV, West Newbury, Mass.	3 Belmont Street
Reedy, Guy Alfred Bailey, IV, Ipswich, Mass.	793 Merrimack Street
Ross, William Cummings, IV, Embo, Scotland	18 Saratoga Street
Sadler, Thomas Sheridan, VI, Billerica, Mass.	———
Schmidt, Otto Emil, IV, Lawrence, Mass.	———
Skofield, Laurel McGary, IV, Haverhill, Mass.	———
Smith, Howard Earle, IV, Nashua, N. H.	———
Stephens, Arnold George, VI, Roslindale, Mass.	37 Varney Street
Tamulonis, Edward William, VI, Nashua, N. H.	———
Topjian, Leon, IV, Lowell, Mass.	98 Fremont Street

Diploma Students.

Class of 1927.

Name, Home Address	*Lowell, Address*
Barry, Leo Joseph, II, Cambridge, Mass.	Delta Kappa Phi House
Battles, Samuel Cook, II, North Andover, Mass.	———
Bronson, Howard Seymour, II, Portage, Wis.	Delta Kappa Phi House
Burtt, Richard Flint, II, Lowell, Mass.	23 Grace Street
Connor, Thomas Francis, II, Roxbury, Mass.	503 Beacon Street
Connorton, John Joseph, Jr., III, Concord Junction Mass.	Delta Kappa Phi House
Darby, Avard Nelson, II, Billerica, Mass.	———
Dods, James Barber, II, Alton, Ont.	51 Sixth Avenue
Feinberg, Benjamin, II, Newton Centre, Mass.	123 Riverside Street
Ferris, Arthur Leon, II, Port Rowan, Ont.	Phi Psi House
Frost, Edgar LeRoy, II, Reading, Mass.	Omicron Pi House
Gallagher, John Waters, II, Danbury, Conn.	Phi Psi House
Greenwood, John Roger, Jr., II, Millbury, Mass.	67 Varnum Avenue
Hanscom, Edwin Thomas, II, Sanford, Me.	10 Roberts Place
Hyde, Alvin Manning, II, East Brimfield, Mass.	Died Oct. 9, 1926
Kenney, Frederick Leo, II, Franklin, Mass.	Delta Kappa Phi House
Leonard, Leo Edward, I, Worcester, Mass.	Phi Psi House
Lussier, Joseph Adrien, II, Woonsocket, R. I.	793 Merrimack Street
Peterson, Halvar Alfred, II, Waltham, Mass.	———
Ryan, David Louis, II, Natick, Mass.	Phi Psi House
Schneiderman, Jacob, III, Dorchester, Mass.	Sigma Omega Psi House
Shedd, Jackson Ambrose, III, North Chelmsford, Mass.	———
Smith, Roger Dennis, II, Haverhill, Mass.	Delta Kappa Phi House
Somers, Samuel Jack, II, Brookline, Mass.	———
Stass, John George, II, Lowell, Mass.	10 Roberts Place
Strout, Kenneth Edward, III, South Portland, Me.	37 Varney Street
Waite, Byron Osmond, I, Livermore Falls, Me.	272 Merrimack Street

Class of 1928.

Bauer, Harold Conrad, III, Lawrence, Mass.	———
Biggi, Harrison Andrew, III, Bedford, Mass.	———
Billings, Borden Dickinson, III, Auburndale, Mass.	Delta Kappa Phi House
Bottomley, John, III, North Andover, Mass.	———
Campbell, William Malcolm, III, South Boston, Mass.	37 Varney Street
Coffey, Daniel Joseph, III, Pittsfield, Mass.	37 Varney Street
Davidson, Sydney, III, Roxbury, Mass.	———
deJong, Simon Sylvain, II, Brookline, Mass.	Sigma Omega Psi House
Evans, Paul Richard, II, Stoneham, Mass.	———
Gaudet, Walter Urban, II, Pawtucket, R. I.	115 Mt. Vernon Street
Hyman, Wolfred, II, Roxbury, Mass.	227 Pawtucket Street
Joslin, Harold Wheeler, II, Milford, N. H.	51 Sixth Avenue
MacKinnon, Howard Arthur, III, Roslindale, Mass.	———
Maguire, James Joseph, II, North Attleboro, Mass.	793 Merrimack Street
Pearlstein, Maxwell, III, Dorchester, Mass.	———
Pease, Cecil Jay, II, Lowell, Mass.	299 Dutton Street
Pratt, Wallace Heywood, Jr., II, Braintree, Mass.	14 Mt. Washington Street
Stott, John Smith, III, North Andover, Mass.	———
Swanson, John Harold, I, Griffin, Ga.	Delta Kappa Phi House
Walker, Ian Campbell, II, Gardner, Mass.	118 Mt. Washington Street

Class of 1929.

Brook, Joseph Johnson, II, Simcoe, Ont.	118 Mt. Washington Street
Carpenter, Carleton Warner, II, Lowell, Mass.	14 Staples Street
Cluett, Girvin, I, Troy, N. Y.	194 Nesmith Street
Cole, Russell, Jr., II, Nashua, N. H.	37 Varney Street
Fleisher, Arnold Melville, III, Brookline, Mass.	123 Riverside Street
Glidden, Reginald Williams, III, Madison, Me.	118 Mt. Washington Street
Gray, Richard Frank, II, Lowell, Mass.	291 Foster Street
Greenbaum, Herbert Baron, III, Roxbury, Mass.	———
Kilton, Lyman Hayward, Jr., II, Lowell, Mass.	1599 Middlesex Street
Stewart, Earl Stanley, II, Somerville, Mass.	———
Williams, Roger, Jr., II, Canton, Mass.	Omicron Pi House
Wong, Pahin Guy, I, Shanghai, China	35 Mount Vernon Street

Special Students.

Adams, Durward Webster, III, Claremont, N. H.	Omicron Pi House
Bailly, Louis, IV, Lowell, Mass.	137 Crawford Street
Brookins, John Frederick, III, Oakland, Me.	299 Dutton Street
Colmer, Charles Crispin, III, Lowell, Mass.	25 B Street
Enright, Edward Barth, III, Nashua, N. H.	———
Forgeot, George Cutler, Jr., IV, Boston, Mass.	43 Plymouth Street
Frost, Robert Jones, III, East Douglas, Mass.	100 Riverside Street
Hope, Gordon Raymond, I, Melrose, Mass.	———
Howe, Frederic William, Jr., A.B., III, Providence, R.I.	The Marlborough
Marble, Roger Houghton, VI, Worcester, Mass.	Phi Psi House
Mears, Charles Joseph, III, Quechee, Vt.	Delta Kappa Phi House
Milliman, Arthur Smith, I, Loudonville, N. Y.	14 Mt. Washington Street
Morris, Harold Edmund, II, Nashua, N. H.	———
Muzzey, Harland Andrew, I, Nashua, N. H.	———
O'Rourke, Edward, III, Claremont, N. H.	446 Merrimack Street
Qualters, Edward Francis, III, Ashuelot, N. H.	37 Varney Street
Riedel, Robert Albert, II, Dorchester, Mass.	Omicron Pi House
Robinson, Marjorie Lorettor, IV, West Somerville, Mass.	193 Avon Street
Saraiya, Anandji Laxmidas, III, Bhuj, India	35 Mount Vernon Street
Savage, Lawrence Alexander, I, Lowell, Mass.	Omicron Pi House
Slamin, Alfred Francis, II, Lowell, Mass.	37 Varney Street
Watts, Stirling, I, Lowell, Mass.	14 Mt. Washington Street
Wetherbee, Francis Putney, I, Albany, Ga.	100 Riverside Street
Yassavidge, Adam, III, Claremont, N. H.	———

ALPHABETICAL LIST OF GRADUATES.

The following list has been corrected in accordance with information received previous to February 1, 1927. Any information regarding incorrect or missing addresses is earnestly solicited.

B.T.C. indicates the degree of Bachelor of Textile Chemistry; B.T.D. indicates the degree of Bachelor of Textile Dyeing; B.T.E. indicates the degree of Bachelor of Textile Engineering; D indicates a diploma; C indicates a certificate (covering a partial course only). Degrees were issued beginning with the year 1913.

Abbot, Edward Moseley, II, '04 (D). Manufacturer, Abbot Worsted Company, Graniteville, Mass.
Abbott, George Richard, II, '08 (D). Andover, Mass.
Adams, Floyd Willington, VI, '16 (B.T.E.). Superintendent, The Barrett Company, Peoria, Ill.
Adams, Henry Shaw, I, '05, (D). Secretary and Treasurer, Eureka Cotton Mills and The Springstein Mills, Chester, S. C.
Adams, Tracy Addison, IV, '11 (D). Division Superintendent, Arnold Print Works, North Adams, Mass.
Albrecht, Charles Henry, IV, '17 (B.T.C.). Chemist, Bell Company, Worcester, Mass.
Almquist, George John Edwin, I, '19 (D). Manager, Passaic-Bergen Lumber Company, Ridgewood, N. J.
Anderson, Arthur Illman, IV, '24 (B.T.C.) Chemist, with R. G. Knowland, Chemical Engineer, 88 Broad Street, Boston, Mass.
Anderson, Arthur Julius, IV, '19 (B.T.C.). Salesman, National Aniline and Chemical Company, 40 Rector Street, New York City.
Anderson, Clarence Alfred, VI, '25 (B.T.E.). Production Department, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.
Anderson, Harold Robert, II, '26 (D). Assistant Mechanical Engineer, American Mason Safety Tread Company, Lowell, Mass.
Annan, David, II, '23 (D). Overseer, Union Textile Corporation, Worcester, Mass.
Arienti, Peter Joseph, IV, '10 (D). Chief Chemist and Dyer, Sayles Finishing Plants, Inc., Saylesville, R. I.
Arundale, Henry Barnes, II, '07 (D). Research and Inspection Department, United States Testing Company, Inc., 316 Hudson Street, New York City.
Atwood, Henry Jones, II, '23 (D). Assistant Designer, Leominster Worsted Company, Leominster, Mass.
Avery, Charles Henry, II, '06 (D). Died January, 1913.

Babigan, Raymond, IV, '24 (B.T.C.). Junior Examiner, United States Patent Office, Washington, D. C.
Bachelder, Charles Edward, IV, '24 (B.T.C.). Dye Chemist, American Cellulose and Chemical Company, Inc., Ltd., Amcelle, Md.
Bailey, Joseph W., I, '99 (D). Agent, Butler Mill, New Bedford, Mass.
Bailey, Lester Harold, IV, '24 (B.T.C.). Textile Chemist, Pacific Mills, Lawrence, Mass.
Bailey, Walter James, IV, '11 (D). Bailey's Cleansers and Dyers, Watertown, Mass.
Baker, Franz Evron, VI, '26 (B.T.E.). Research Department, Cotton Research Company, Boston Mass.
Baker, Maurice Sidney, IV, '25 (B.T.C.). Textile Chemist, Weller, Krouse Company, Sharon, Pa.
Baker, William John, IV, '16 (D).
Baker, William Samuel, I, '26 (D). With Nashua Manufacturing Company, Nashua, N. H.
Baldwin, Arthur Lincoln, IV, '00 (D). Died December 1, 1919.
Baldwin, Frederick Albert, II, '04 (D). Vice-President and Secretary, Walter Blue & Co., Ltd., Sherbrooke, Que.
Ballard, Horace W. C. S., IV, '08 (D). Died September 28, 1918.

Experimental Dyeing Laboratory

Barlofsky, Archie, VI, '17 (B.T.E.). Merchant, Economy Cash Market, 165 Chelmsford Street, Lowell, Mass.

Barr, I. Walwin, I, '00 (D). With Buckley Brothers, 881 Broadway, New York City.

Barrett, Andrew Edward, IV, '23 (B.T.C.). With Uhlig Piece Dye Works, Haledon, N. J.

Beck, Frederic Christian, II, '24 (D). In business, Weld & Beck, Southbridge, Mass.

Bell, Edward Benjamin, IV, '24 (B.T.C.). Overseer of Dyeing, Faulkner & Colony Manufacturing Co., Keene, N. H.

Bennett, Edward Howard, II, '03 (C). Publisher, American Wool and Cotton Reporter, 530 Atlantic Avenue, Boston, Mass.

Bennett, Herbert Bowen, II, '13 (D). Died January 23, 1920.

Bentley, Byron, II, '26 (D). With Joseph Bentley Hair Company, Methuen, Mass.

Berry, Wilbur French, II, '17 (D). Manager and Treasurer, Wilbur Manufacturing Company, Providence, R. I.

Bienstock, George Jerrard, III, '24 (D). Mill Department Head, Noveltex, Inc., 82 Franklin Street, New York City.

Bigelow, Prescott Fenno, II, '12 (D). Died October 14, 1918.

Bird, Clarence Henry, II, '22 (D). Assistant Superintendent, Worcester Woolen Mill Company, Worcester, Mass.

Bird, Francis John, VI, '22 (B.T.E.). 30 West Street, Attleboro, Mass.

Blaikie, Howard Mills, II, '11 (D). Salesman and Assistant Styler, American Woolen Company, 225 4th Avenue, New York City.

Blake, Parker Gould, VI, '14 (D). District Manager, Claude Denis & Co., Ltd., Toronto, Ont.

Blanchard, John Lawrence, II, '23 (D). With Pondicherry Woolen Company, Bridgton, Me.

Bloom, Wilfred Nathaniel, IV, '03 (D). Died August 17, 1918.

Bodwell, Henry Albert, II, '00 (D). Treasurer and Sales Manager, Smith & Dove Manufacturing Company, Andover, Mass.

Booth, James Mooney, IV, '24 (B.T.C.). 218 Myrtle Avenue, Boonton, N. J.

Boyd, George Andrew, I, '05 (D). Assistant Treasurer, Harmony Mills, Cohoes, N. Y.

Boylston, Theodore Willmott, IV, '21 (B.T.C.). Died June 3, 1921.

Brackett, Martin Richard, II, '22 (D). With D. S. Mackay & Co., 215 Fourth Avenue, New York City.

Bradford, Harold Palmer, II, '25 (D). 90 Beach Street, Malden, Mass.

Bradford, Roy Hosmer, II, '06 (D). 138 Main Street, Andover, Mass.

Bradley, Raymond Frost, VI, '14 (D). Garage Proprietor, Twin Light Garage Company, 267 East Main Street, Gloucester, Mass.

Bradley, Richard Henry, V, '01 (C). Overseer, Wamsutta Manufacturing Company, New Bedford, Mass.

Brainerd, Arthur Travena, IV, '09 (D). Salesman, General Dyestuff Corporation, 305 West Randolph Street, Chicago, Ill.

Brainerd, Carl Emil, IV, '20 (B.T.C.). Overseer of Dyeing, F. C. Huyck & Sons, Albany, N. Y.

Brainerd, Carroll Lewis, IV, '19 (B.T.C.). With Waldrich Bleachery, Delawanna, N. J.

Brandt, Carl Dewey, VI, '20 (B.T.E.). Superintendent of Finishing, Lowell Bleachery South, Experiment, Ga.

Brannen, Leon Vincent, III, '07 (C).

Brickett, Chauncy Jackson, II, '00 (D). Director, School of Textiles, International Correspondence School, Scranton, Pa.

Brickett, Raymond Calvin, II, '14 (D). Overseer, M. T. Stevens & Sons Company (Marland Mills), Andover, Mass.

Brigham, Howard Mason, VI, '24 (B.T.E.). With Hunter Manufacturing and Commission Company, 60 Worth Street, New York City.

Brown, Gerald Marston, VI, '22 (B.T.E.). With Monomac Spinning Company, Lawrence, Mass.

Brown, Philip Franklin, II, '23 (D). Sales Department, DuPont Rayon Company, 132 Madison Avenue, New York City.

Brown, Rollins Goldthwaite, IV, '12 (D). Sales Representative, White Brothers, Inc., Winchendon Springs, Mass.

Brown, Russell Lee, VI, '21 (B.T.E.). Assistant Superintendent, M. T. Stevens & Sons Co., Franklin, N. H.

Brown, Will George, Jr., IV, '22 (B.T.C.) Chief Chemist, American Hide & Leather Company, Lowell, Mass.

Buchan, Donald Cameron, II, '01 (D). Assistant Superintendent, M. T. Stevens & Sons Company, North Andover, Mass.

Buchan, Norman Spaulding, IV, '26 (B.T.C.). Assistant Dyer, M. T. Stevens & Sons Co., (Marland Mills), Andover, Mass.

Burbeck, Dorothy Maria, IV, '20 (B.T.C.). See Garlick, Mrs. Dorothy M.

Burger, Samuel Joseph, III, '24 (D). With Harrison Studio, Harrison, N. Y.

Burnham, Frank Erwin, IV, '02 (D). Chief Chemist, Farwell Bleachery, Lawrence, Mass.

Burrage, Katharine C., IIIb, '99 (C). Died May 16, 1914.

Callahan, John Joseph, Jr., II, '26 (D). With Arlington Mills, Lawrence, Mass.

Cameron, Elliott Francis, IV, '11 (D). Treasurer, Amos F. Chase Company, Inc., 13 Otis Street, Boston, Mass.

Campbell, Alexander, VI, '23 (B.T.E.). Resident Engineer, John A. Stevens, Engineer, 16 Shattuck Street, Lowell, Mass.

Campbell, Laura Etta, IIIb, '00 (C). Deceased.

Campbell, Louise Porter, IIIb, '03 (C). With Ginn & Co., 15 Ashburton Place, Boston, Mass.

Campbell, Orison Sargent, II, '03 (D). Manager Felt Department, Canadian Consolidated Felt Company, Ltd., Kitchener, Ont.

Cannell, Philip Stuart, VI, '23 (B.T.E.). Safety Engineer, Employers Liability Assurance Corporation, New Haven, Conn.

Carr, George Everett, I, '05 (D).

Carr, Paul Edward, II, '24 (D). 38 Glenwood Avenue, Cambridge, Mass.

Carter, Robert Albion, IV, '02 (D). Salesman, E. I. du Pont de Nemours & Co., 128 South Front Street, Philadelphia, Pa.

Carter, Russell Albert, II, '25 (D). With Mohawk Carpet Mills, Inc., Amsterdam, N. Y.

Cary, Julian Clinton, VI, '10 (D). Branch Manager, American Mutual Liability Insurance Company, 226 Pearl Street, Hartford, Conn.

Caya, Ferdinand Joseph, IV, '22 (B.T.C.). Superintendent of Dyeing and Chemist, Onyx Hosiery, Inc., Wharton, N. J.

Chamberlin, Frederick Ellery, I, '03 (D). Overseer of Spinning, Monument Mills, Housatonic, Mass.

Chandler, Proctor, IV, '11 (D). President, Chandler Manufacturing Company, 28 Carleton Street, Cambridge, Mass.

Chang, Chi, VI, '23 (B.T.E.).

Chang, Wen Chuan, VI, '21 (B.T.E.). Dah Sung Cotton Mill No. 1, Nantung, Kiangsu, China.

Chapman, Leland Hildreth, VI, '24 (B.T.E.). Instructor, Brewster Academy, Wolfeboro, N. H.

Chen, Shih Ching, IV, '22 (B.T.C.). Hou Sung Cotton Mill, Shanghai, China.

Chen, Wen-Pei, IV, '24 (B.T.C.).

Chisholm, Lester Bury, I, '11 (D). General Plant Manager, Everlastik, Inc., Chelsea, Mass.

Church, Charles Royal, II, '06 (C).

Churchill, Charles Whittier, III, '06 (D). Manager, Churchill Manufacturing Company, Inc., Lowell, Mass.

Clapp, Frank Austin, II, '04 (D). Selling Agent, South Bend Woolen Mills, Inc., 215 4th Avenue, New York City.

Clark, Earl William, IV, '18 (B.T.C.). Chemist, Comstock & Wescott, Inc., Niagara Falls, N. Y.

Clark, Thomas Talbot, II, '10 (D). Treasurer, Talbot Mills, North Billerica, Mass.

Clarke, George Dean, II, '21 (C). Dyer, Seaman & Cobb Thread Mills, Hopkinton, Mass.

Clayton, Harold Edmund, VI, '21 (B.T.E). Superintendent, Bolton & Torrance Co., Bennington, Vt.

Cleary, Charles Joseph, II, '13 (D). Textile Technologist, United States Army Air Service, McCook Field, Dayton, Ohio.

Clement, David Scott, IV, '24 (B.T.C.). With Braemor Mills, Inc., Pascoag, R. I.

Clifford, Albert Chester, VI, '22 (B.T.E.). Assistant Engineer, Western Electric Company (Hawthorne Works), Chicago, Ill.

Clogston, Raymond B., IV, '04 (D). Superintendent of Dyeing, Merrimack Manufacturing Company, Lowell, Mass.

Coan, Charles Bisbee, IV, '12 (D). Demonstrator and Salesman, Jennings & Co., 93 Broad Street, Boston, Mass.

Cohen, Arthur Edward, IV, '23 (B.T.C.).

Cohen, Raphael Edvab, IV, '25 (B.T.C.). With Gotham Silk Hosiery Company, New York City.

Colby, James Tracy, VI, '16 (D). Salesman, F. C. Huyck & Sons, Albany, N. Y.

Cole, Edward Earle, IV, '06 (D). Reporter, The Bradstreet Company, Boston, Mass.

Cole, James Thomas, II, '05 (D). Treasurer, Arlington Industries for the Blind, Arlington, Mass.

Collonan, Herbert Joseph, II, '22 (D). Assistant Designer, Beoli Mills, Fitchburg, Mass.

Coman, James Groesbeck, I, '07 (D). Superintendent, Mexia Textile Mills, Mexia, Texas.

Conant, Harold Wright, I, '09 (D). Treasurer and Manager, Conant, Houghton & Co., Inc., Littleton, Mass.

Conant, Richard Goldsmith, I, '12 (D). Sales Executive, Wellington, Sears & Co., 93 Franklin Street, Boston, Mass.

Conklin, Jennie Grace, IIIb, '05 (C). See Nostrand, Mrs. William L.

Cook, Kenneth Bartlett, I, '13 (D). Manager, United States Rubber Company, Textile Section, Orange, N. J.

Cosendai, Edwin Frederick Ernest, IV, '15 (B.T.D.). Died November 1, 1923.

Coté, Theodore Charles, IV, '26 (B.T.C.). Research Chemistry, Pacific Print Works, Lawrence, Mass.

Craig, Albert Wood, IV, '07 (D). Superintendent, Windsor Print Works, North Adams, Mass.

Craig, Clarence Eugene, III, '02 (D).

Creese, Guy Talbot, IV, '14 (D). Chemist, Creese & Cook Company, Danversport, Mass.

Crowe, Joseph Bailey, IV, '25 (B.T.C.). Textile Chemist, Procter & Gamble Co., Ivorydale, Ohio.

Culver, Ralph Farnsworth, IV, '04 (D). Vice-President and Manager, Ciba Company, Inc., 61 Peck Street, Providence, R. I.

Cummings, Edward Stanton, VI, '16 (D). With R. E. Loper & Co., Industrial Engineers, Grenville, S. C.

Curran, Charles Ernest, III, '02 (C). Head Designer, Wood Worsted Mills, Lawrence, Mass.

Currier, Herbert Augustus, I, '06 (D). Manager, New York Yarn Department, Wm. Whitman Company, Inc., 25 Madison Avenue, New York City.

Currier, John Alva, II, '01 (D). Superintendent, Pentucket Mills (M.T. Stevens & Sons Company), Haverhill, Mass.

Curtis, Frank Mitchell, I, '06 (D). Lumber Merchant, Wm. Curtis Sons Company, 30 Eustis Street, Roxbury, Mass.

Curtis, William Leavitt, II, '05 (C).

Cutler, Benjamin Winthrop, Jr., III, '04 (D).

Cuttle, James H., II, '99 (D).

Dalton, Gregory Smith, IV, '12 (D).

Datar, Anant Vithal, VI, '24 (B.T.E.). Inchalkaranji (S. M. Cy), India.

Davieau, Alfred Edward, VI, '16 (D). In charge of Textile Testing, United States Testing Company, Inc., 316 Hudson Street, New York City.

Davieau, Arthur Napoleon, VI, '13 (D). Superintendent, Kenwood Mills, Ltd. (F. C. Huyck & Sons), Arnprior, Ont.

Davieau, Leon Arthur, VI, '23 (B.T.E.). With Pacific Mills, Lawrence, Mass.

Davis, Alexander Duncan, VI, '14 (B.T.E.). Instructor, Northeastern University, Springfield, Mass.

Dearborn, Roy, VI, '13 (D). Purchasing Agent, Brightwood Manufacturing Company, North Andover, Mass.

Dearth, Elmer Ellridge, IV, '12 (D). General Superintendent, Fisk Rubber Company, Federal Division, Cudahy, Wis.

Del Plaine, Parker Haywood, IV, '25 (B.T.C.). Textile Chemist, Rohm & Haas Company, Bristol, Pa.

Derby, Roland Everett, IV, '22 (B.T.C.). Dyer, Lowell Dye Works, Lowell, Mass.

de Sa, Francisco, VI, '18 (B.T.E.). Avenue da Graca, Bahia, Brazil.

Dewey, James French, II, '04 (D). Woolen Manufacturer, A. G. Dewey Company, Quechee, Vt.

Dewey, Maurice William, II, '11 (D). Inspector of Real Estate and Real Estate Loans, National Life Insurance Company, Montpelier, Vt.

Dillon, James Henry, III, '05 (D). Land Developing and Colonizing, 512 Summer Building, St. Petersburg, Fla.

Donald, Albert Edward, II, '04 (D). Agent, Hecla Mill (American Woolen Company), Uxbridge, Mass.

Donovan, Joseph Richard, IV, '24 (B.T.C.) 22 Romsey Street, Dorchester, Mass.

Doran, Wilbur Kirkland, II, '22 (D). Instructor, Manchester High School, Manchester, N. H.

Dorr, Clinton Lamont, VI, '14 (D). Manager, Raymond Syndicate, 356 Washington Street, Boston, Mass.

Douglas, Walter Shelton, II, '21 (D). 12 Bertram Street, Lowell, Mass.

Duguid, Harry Wyatt, I, '24 (D). Office Manager, Maverick Mills, East Boston, Mass.

Dunnican, Edward Tunis, VI, '24 (B.T.E.). Second Hand, Pacific Mills, Lawrence, Mass.

Durgin, William Ernest, IV, '24 (B.T.C.). Textile Chemist, Geigy & Co., Inc., 88 Broad Street, Boston, Mass.

Duval, Joseph Edward, II, '10 (D). Yarn Agent, 308 Chestnut Street, Philadelphia, Pa.

Dwight, John Francis, Jr., II, '08 (D). Proprietor, Humarock Inn, Humarock Mass.

Echmalian, John Gregory, VI, '16 (B.T.E.). With Cheney Brothers, So. Manchester, Conn.

Ehrenfried, Jacob Benjamin, II, '07 (C). With George Ehrenfried Company, Lewiston, Me.

Elliot, Gordon Baylies, II, '12 (D). Production Work, Reed & Prince Manufacturing Company, Worcester, Mass.

Ellis, Charles Albert, VI, '21 (B.T.E.). In business, de Camp & Ellis, Ocala, Fla.

Ellis, Dorothy Myrta, VI, '25 (B.T.E.). Assistant to Employment Manager, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.

Emerson, Frank Warren, II, '03 (D). Agent, Standish Worsted Company, Penacook, N. H.

Engstrom, Karl Emil, VI, '12 (D). (S.B. 1916, Massachusetts Institute of Technology.) With Lockwood, Greene & Co., Boston, Mass.

Enloe, Winfred Paige, I, '22 (D). Assistant Superintendent, W. A. Handley Manufacturing Company, Roanoke, Ala.

Evans, Alfred Whitney, III, '03 (D).

Evans, William Robinson, III, '03 (D). 309 Main Street, Bradford, Mass.

Everett, Charles Arthur, IV, '19 (B.T.C.). Instructor, Dyeing Department, Lowell Textile School, Lowell, Mass.

Ewer, Nathaniel Trull, IV, '01 (D). Chemist, American Dyewood Company, Chester, Pa.

Fairbanks, Almonte Harrison, II, '09 (D). Treasurer and Manager, Middlesex Knitting Company, Wakefield, Mass.

Farmer, Chester Jefferson, IV, '07 (D). Professor of Chemistry, Northwestern Medical School, Chicago, Ill.

Farnsworth, Harold Vincent, VI, '16 (B.T.E.). Sales Engineer, Atkinson, Haserick & Co., 152 Congress Street, Boston, Mass.

Farr, Leonard Schaefar, II, '08 (D). Assistant Superintendent, No. 2 Mill, Farr Alpaca Company, Holyoke, Mass.

Farwell, Claude Chapman, VI, '23 (B.T.E.). Athletic Director and Head of Science Department, East Greenwich Academy, East Greenwich, R. I.

Farwell, Ray Baldwin, VI, '24, (B.T.E.). Died July 6, 1926.

Feindel, George Paul, IV, '24 (B.T.C.). Chemist, Sayles Finishing Plant, Inc., Saylesville, R. I.

Feldstein, Martin Alexander, VI, '24 (B.T.E.). Production Manager, Amplex Instrument Laboratories, 88 West Broadway, New York City.

Fels, August Benedict, II, '99 (D).

Ferguson, Arthur Feiling, I, '03 (D). With United States Tariff Commission, Washington, D. C.

Ferguson, William Gladstone, III, '09 (D). Manager, Efficiency Department, Ludlow Manufacturing Associates, Ludlow, Mass.

Finlay, Harry Francis, IV, '10 (D). Demonstrator, National Aniline and Chemical Company, Boston, Mass.

Fisher, Russell Todd, VI, '14 (D)., '25 (B.T.E.). Secretary, National Association of Cotton Manufacturers, 80 Federal Street, Boston, Mass.

Fiske, Starr Hollinger, II, '09 (D). Agent and Superintendent, Middlesex Fabric Company, Lowell, Mass.

Fitzgerald, John Francis, IV, '18 (B.T.C.). Dyer, Boston Dye House, Malden, Mass.

Fleischmann, Meyer, IV, '20 (B.T.C.). Chief Chemist, Real Silk Hosiery Mills, Indianapolis, Ind.

Fleming, Frank Everett, IV, '06 (D). Assistant Dyer and Finisher, Goodall Worsted Company, Sanford, Me.

Fletcher, Howard Varnum, III, '25 (D). With North Billerica Company, North Billerica, Mass.

Fletcher, Roland Hartwell, VI, '10 (D). With Pressed Steel Car Company, McKees Rocks, Pa.

Flynn, Thomas Patrick, IV, '11 (D). Salesman, American Aniline Products, Inc., 77 Bedford Street, Boston, Mass.

Ford, Edgar Robinson, IV, '11 (D). Finisher, Sayles Finishing Plants, Saylesville, R. I.

Forsaith, Charles Henry, VI, '20 (B.T.E.). Superintendent, Nashua Manufacturing Company (Jackson Mills), Nashua, N. H.

Forsaith, Ralph Allen, VI, '16 (B.T.E.). Assistant Superintendent, Appleton Company, Lowell, Mass.

Forsyth, Harold Downes, VI, '23 (B.T.E.). Corporation Treasurer, Wm. Forsyth & Sons Co., Lynn, Mass.

Foster, Boutwell Hyde, VI, '17 (B.T.E.). Textile Engineer, Textile Section, United States Rubber Company, 451 South Jefferson Street, Orange, N. J.

Foster, Clifford Eastman, II, '01 (D). Salesman, Wickwire Spencer Steel Company, 41 East 42nd Street, New York City.

Fowle, Edwin Daniels, VI, '24 (B.T.E.). Associate Editor, "Textile World," 65 Franklin Street, Boston, Mass.

Frost, Harold Benjamin, II, '12 (D). Salesman Compensation Department, Liberty Mutual Insurance Company, Park Square Building, Boston, Mass.

Fuller, Allen Reed, IV, '17 (B.T.C.). Chemist, Otis Company, Three Rivers, Mass.

Fuller, George, I, '03 (D). Assistant to the President, Riverside & Dan River Cotton Mills, Inc., Danville, Va.

Gadsby, Arthur Norton, II, '13 (D). Deceased.
Gahm, George Leonhard, II, '06 (D). Superintendent, Yarn Department, Wood Worsted Mills, Lawrence, Mass.
Gainey, Francis William, IV, '11 (D). Colorist, Cheney Brothers, South Manchester, Conn.
Gale, Harry Laburton, III, '10 (D). Designer, Hunter Manufacturing Company, 58 Worth Street, New York City.
Garlick, Mrs. Dorothy M. (Burbeck, Dorothy M.), IV, '20 (B.T.C.). Chemist, Arlington Mills, Lawrence, Mass.
Gay, Olin Dow, II, '08 (D). Superintendent of Woolen Mill, Gay Brothers Company, Cavendish, Vt.
Gerrish, Henry Kilborn, III, '16 (D). Died September 18, 1922.
Gerrish, Walter, III, '03 (D).
Gillie, Stanley James, I, '22 (D). Assistant Superintendent, Paterson Branch, United States Testing Company, Inc., Paterson, N. J.
Gillon, Sara Agnes, IIIb, '06 (C).
Gilman, Ernest Dana, II, '26 (D). With Pacific Mills, Lawrence, Mass.
Godfrey, Harold Thomas, VI, '26 (B.T.E.). With M. T. Stevens & Sons Co., North Andover, Mass.
Goldberg, George, VI, '10 (D). Manufacturer, Liberty Lace and Braid Company, 88 Bedford Street, Boston, Mass.
Goldman, Moses Hyman, IV, '20 (B.T.C.). Research Chemist, National Association of Dyers and Cleaners of United States and Canada, Textile Section of Bureau of Standards, Washington, D. C.
Goller, Harold Poehlmann, II, '23 (D). Sales Department du Pont Rayon Company, Reading, Pa.
Goodhue, Amy Helen, IIIb, '00 (C). See Harrison, Mrs. Arthur.
Gooding, Francis Earle, IV, '19 (B.T.C.). Foreman, Calco Chemical Company, Bound Brook, N. J.
Goosetrey, Arthur, IV, '21 (B.T.C.). Overseer of Dyeing, Keene Silk Fibre Mills, Keene, N. H.
Goosetrey, John Thomas, IV, '21 (B.T.C.). Chemist and Dyer, Rhode Island Lace Works, Inc., West Barrington, R. I.
Gould, Norman Culver, VI, '19 (B.T.E.). Textile Engineer, F. C. Huyck & Sons, Albany, N. Y.
Greenberg, Archie, II, '21 (D). Linenfoot Hosiery Company, Philadelphia, Pa.
Gwinnell, George Harry, II, '25 (D). Assistant Designer, Pontoosuc Woolen Company, Pittsfield, Mass.
Gyzander, Arne Kolthoff, IV, '09 (D). Chemist, National Aniline and Chemical Company, 113 High Street, Boston, Mass.

Haddad, Nassib, VI, '23 (B.T.E.). Draftsman, International Motor Company, New Brunswick, N. J.
Hadley, Richard Francis, IV, '22 (B.T.C.). Salesman, Carbon, Coal & Coke Company, 85 Devonshire Street, Boston, Mass.
Hadley, Walter Eastman, IV, '08 (D). Chief Chemist, The Clark Thread Company, Newark, N. J.
Hadley, Wilfred Nourse, II, '22 (D). With Parks & Woolson Company, Springfield, Vt.
Hager, Hazen Otis, II, '21 (C).
Hall, Frederick Kilby, VI, '24 (B.T.E.). Technical Department, National Association of Cotton Manufacturers, 80 Federal Street, Boston, Mass.
Halsell, Elam Ryan, I, '04 (C). Assistant Superintendent, Whittenton Manufacturing Company, Taunton, Mass.
Hammond, Chester Twombly, II, '23 (D). Assistant to Wool Buyer, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.
Hardie, Newton Gary, I, '23 (D). Assistant Superintendent, Stonecutter Mills Company, Inc., Spindale, N. C.

Hardy, Philip Lewis, VI, '10 (D). Contractor, Andover, Mass.
Harmon, Charles Francis, I, '99 (D).
Harrington, Thomas, IV, '15 (D). Superintendent, Monarch Leather Company, 1127 West Division Street, Chicago, Ill.
Harris, Charles Edward, I, '05 (D). Treasurer and General Manager, Martin Fifth Wheel and Trailer Corporation, Easthampton, Mass.
Harris, George Simmons, I, '02 (C). President and General Manager, Exposition Cotton Mills, Atlanta, Ga.
Harrison, Mrs. Arthur (Goodhue, Amy Helen), IIIb, '00 (C). R. F. D. No. 2, Lowell, Mass.
Hart, Arthur Norman, IV, '19 (B.T.C.). Chemist, Crystal Analysis Company, Chicago, Ill.
Hart, Howard Roscoe, I, '23 (D). With Stonecutter Mills Company, Inc., Spindale, N. C.
Haskell, Spencer Howard, II, '07 (D). Deceased.
Haskell, Walter Frank, IV, '02 (D). Overseer of Dyeing, Dana Warp Mills, Westbrook, Me.
Hassett, Paul Joseph, IV, '12 (D). Production Manager, Supplies Division, L. C. Smith & Corona Typewriters, Inc., Syracuse, N. Y.
Hathaway, William Tabor, II, '26 (D). With Percy Legge & Co., Boston, Mass.
Hathorn, George Wilmer, IV, '07 (D). Chemist, Lawrence Gas Company, Lawrence, Mass.
Hathorne, Berkeley Lewis, IV, '24 (B.T.C.). Chemist and Boss Dyer, Pitman Manufacturing Company, Laconia, N. H.
Hay, Ernest Crawford, II, '11 (D). Superintendent, Monomac Spinning Company, Lawrence, Mass.
Hendrickson, Walter Alexander, II, '11 (D). With National Knitting Company, 905 Clinton Street, Milwaukee, Wis.
Hennigan, Arthur Joseph, II, '06 (D). President, Seneca Manufacturing Company, and New England Representative, Cox & Schreiber, of New York, 31 Bedford Street, Boston, Mass.
Hibbard, Frederick William, IV, '25 (B.T.C.). Chemist, Appleton Company Lowell, Mass.
Hildreth, Harold William, II, '07 (D). Granite Dealer, Westford, Mass.
Hillman, Ralph Greeley, VI, '22 (B.T.E.). Assistant Superintendent, Samson Cordage Works, Shirley, Mass.
Hindle, Milton, VI, '25 (B.T.E.). Textile Engineer, F. C. Huyck & Sons, Albany, N. Y.
Hintze, Thomas Forsyth, I, '06 (C). Vice-President and Chief Engineer, Gas Engineering Corporation, New York City.
Hodge, Harold Bradley, VI, '22 (B.T.E.). Chief Engineer, J. C. and W. T. Monahan, Civil Engineers and Surveyors, 219 Central Street, Lowell, Mass.
Hoffman, Richard Robert, II, '21 (C). Assistant Designer, Beoli Mills, Fitchburg, Mass.
Holden, Francis Crawford, IV, '09 (D). Chemist, Chelsea Fibre Mills, 1155 Manhattan Avenue, Brooklyn, N. Y.
Holden, John Sanford, II, '20 (D). Manufacturer, Automatic Machine Products' Company, Attleboro, Mass.
Holgate, Benjamin, III, '02 (C). Agent, Boott Mills, Lowell, Mass.
Hollings, James Louis, I, '05 (D). Buyer and Converter (Cotton Goods), W. R. Grace & Co., 7 Hanover Square, New York City.
Hollstein, William Diedrick, VI, '25 (B.T.E.). Sales Department, Schwarzenbach, Huber & Co., New York City.
Holmes, Otis Milton, VI, '13 (B.T.E.). Draftsman, United Shoe Machinery Corporation, Beverly, Mass.
Hood, Leslie Newton, IV, '12 (D). Chemist, Union Bleachery, Greenville, S. C.
Hook, Russell Weeks, IV, '05 (D). Chemist in charge of Textile Department, Arthur D. Little, Inc., 30 Charles River Road, Cambridge, Mass.
Horne, James Albert, I, '24 (D). With Carl Stohn, Inc., Hyde Park, Mass.
Horsfall, George Gordon, II, '04 (C). Assistant Dyer, Interwoven Mills, Inc., Martinsburg, W. Va.

Horton, Chester Temple, VI, '14 (B.T.E.). Wilmington, Mass.

Houghton, Robert Kingsbury, IV,'23 (B.T.C.). Finisher, Sayles Finishing Plants, Inc., Saylesville, R. I.

Howarth, Charles Lincoln, IV, '17 (B.T.C.). Assistant Professor of Dyeing, Lowell Textile School, Lowell, Mass.

Howe, Woodbury Kendall, I, '10 (D). Assistant Superintendent, Merrimack Manufacturing Company, Lowell, Mass.

Hoyt, Charles William Henry, IV, '07 (D).

Hsu, Hsueh-Chang, VI, '23 (B.T.E.).

Hubbard, Harold Harper, I, '22 (D). Overseer, Royal River Manufacturing Company, Yarmouth, Me.

Hubbard, Ralph King, IV, '11 (D). Treasurer and Manager, Packard Mills Inc., Webster, Mass.

Huising, Gerónimo Huerva, I, '08 (D). Farmer, Hda "Perseverancia," San José, Mindoro, P. I.

Hunt, Chester Lansing, III, '05 (C).

Hunton, John Horace, II, '11 (D). Treasurer, Newichawanick Company, South Berwick, Me.

Hurtado, Leopoldo, Jr., VI, '10 (D). General Manager, Hurtado & Co., Uruapan, Michoacán, Mex.

Hurwitz, Jacob, IV, '23 (B.T.C.).

Hutton, Clarence, III, '03 (C). Editor, "Textile World," 65 Franklin Street, Boston, Mass.

Irvine, James Andrew, VI, '17 (B.T.E.). Educational Director, Cheney Brothers, South Manchester, Conn.

Isaacson, George Franklin, II, '26 (D). Assistant Designer, Hoosac Cotton Mills, North Adams, Mass.

Jaeger, Robert William, Jr., IV, '23 (B.T.C.). Research Chemist, Armour & Co., Chicago, Ill.

Jelleme, William Oscar, I, '10 (D). With Cohn-Hall-Marx Company, 93 Franklin Street, New York City.

Jen, Shang Wu, I, '21 (D).

Jenckes, Leland Aldrich, VI, '08 (D). Deceased.

Jessop, Charles Clifford, VI, '22 (B.T.E.). Development Engineer, Crex Carpet Company, St. Paul, Minn.

Johnson, Arthur Kimball, IV, '13 (D) (S.B. 1917 Massachusetts Institute of Technology). Instructor in Chemistry, Lowell Textile School, Lowell, Mass.

Johnson, George Henry, IV, '20 (B.T.C.). Director of Research, Mellon Institute, Laundry Owners National Association, Pittsburgh, Pa.

Johnson, Philip Stanley, IV, '24 (B.T.C.). Advertising Manager, "Clearwater Sun", Clearwater, Fla.

Jones, Everett Amos, III, '05 (D). Superintendent and Assistant Secretary, Nye & Wait Kilmarnock Corporation, Auburn, N. Y.

Jones, Nathaniel Erskine, I, '21 (D). Instructor, Cotton Yarns and Knitting, Lowell Textile School, Lowell, Mass.

Joy, Thomas, VI, '26 (B.T.E.). Development and Research Engineering, United States Rubber Company, Orange, N. J.

Jury, Alfred Elmer, IV, '04 (D). Director, General Laboratories, United States Rubber Company, 561 West 58th Street, New York City.

Kaatze, Julius, VI, '22 (B.T.E.). Salesman, Toledo Scale Company, Lawrence, Mass.

Kao, Chieh-Ching, VI, '23 (B.T.E.).

Karanfilian, John Hagop, VI, '21 (B.T.E). 5508 Chester Avenue, West Philadelphia, Pa.

Kay, Harry Pearson, II, '09 (D). 44 Marion Street, Brookline, Mass.

Kendall, Charles Henry, II, '23 (D). Superintendent, Bridgewater Woolen Company, Bridgewater, Vt.

Finishing Department

Kennedy, Francis Charles, VI, '26 (B.T.E.). Fabric Development, The Fisk Rubber Company, Chicopee Falls, Mass.
Kent, Clarence LeBaron, III, '06 (C). Station Agent, Standard Oil Company Rochester, N. H.
Keough, Wesley Lincoln, II, '10 (D). With E. A. Pierce & Co., Pasadena, Calif.
Kingsbury, Percey Fox, IV, '01 (D). Print Manager, Passaic Print Works, Passaic, N. J.
Knowland, Daniel Power, IV '07 (D). Chemist, Geigy Company, Inc., 89 Barclay Street, New York City.
Knox, Joseph Carleton, VI, '23 (B.T.E.). Assistant Foreman, Insulating Department, Simplex Wire and Cable Company, East Cambridge, Mass.
Kuo, Limao, VI, '26 (B.T.E.). With Scott & Williams, Inc., Laconia, N. H.

Lakeman, Fannie Shillaber, IIIb, '00 (C). Died February 8, 1921.
Lamb, Arthur Franklin, II, '10 (D). Rockland, Me.
Lamont, Robert Laurence, II, '12 (D).
Lamprey, Leslie Balch, IV, '16 (B.T.D.) 173 Parker Street, Lawrence, Mass.
Lamson, George Francis, I, '00 (D). With Ludlow Manufacturing Associates, Ludlow, Mass.
Lane, John Williams, I, '06 (C).
Lane, Oliver Fellows, IV, '15 (B.T.D.). Chemist, Head of Color Making Department, Lowe Paper Company, Ridgefield, N. J.
Larratt, John Francis, II, '22 (D). Assistant Overseer, Kinney Worsted Yarn Company, Pittsfield, Mass.
Laughlin, James Knowlton, III, '09 (D).
Laurin, Eric Thursten Lawrence, IV, '21 (B.T.C.). Textile Chemist and Colorist, Sayles Finishing Plants, Inc., Saylesville, R. I.
Laurin, Sven Albert, IV, '23 (B.T.C.). Assistant Dyer, Slatersville Finishing Company, Slatersville, R. I.
Leach, John Pelopidas, I, '00 (C). Farming, Littleton, N. C.
Leavitt, George Herbert, II, '26 (D). With F. C. Huyck & Sons, Albany, N.Y.
Lee, William Henry, II, '05 (C). Treasurer, Lee's Wool Shop, 207 Pine Street, Holyoke, Mass.
Leitch, Harold Watson, IV, '14 (B.T.D.). Chemical Engineer, M. T. Stevens & Sons Co., Franklin, N. H.
Lemire, Joseph Emile, VI, '21 (B.T.E.). In Real Estate Business, Lowell, Mass.
Levi, Alfred Sandel, IV, '09 (D). Vice-President, Liondale Bleach, Dye and Print Works, Rockaway, N. J.
Lewis, George Kenneth, VI, '24 (B.T.E.). Overseer, Jackson Mills (Nashua Manufacturing Company), Nashua, N. H.
Lewis, LeRoy Clark, IV, '08 (D). Representative National Silk Throwing Company, Paterson, N. J.
Lewis, Walter Scott, IV, '05 (D). Special Expert in Textiles, United States Tariff Commission, Washington, D. C.
Lillis, Marvin Hale, IV, '14 (D). With Marland Mills, Andover, Mass.
Linsey, Edward, II, '25 (D). Production Department, Mohawk Carpet Mills Inc., Amsterdam, N. Y.
Lombard, Carleton Joshua, VI, '23 (B.T.E.). With Curtis & Marble Machine Company, Worcester, Mass.
Loney, Robert William, II, '22 (D). Foreman, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.
Longbottom, Parker Wyman, IV, '21 (B.T.C.). Chemist, Watson Park Company, 165 High Street, Boston, Mass.
Lowe, Philip Russell, VI, '24 (B.T.E.). With Smith & Dove Manufacturing Company, Andover, Mass.
Lucey, Edmund Ambrose, II, '04 (D). President, Wm. A. Tottle & Co., Inc., Baltimore, Md.

McCann, John Joseph, Jr., VI, '24 (B.T.E.).
McCool, Frank Leslie, IV, '10 (D). Vice-President, S. R. David & Co., Inc., 252 Congress Street, Boston, Mass.

Macdonald, Hector Graham, IV, '19 (B.T.C.). Chemist, Franklin Process Company, Providence, R. I.
McDonnell, William Henry, I, '06 (C). Lawyer, McDonnell & White, 40 Court Street, Boston, Mass.
McGowan, Frank Robert, VI, '15 (B.T.E.). Textile Engineer, Washington, D. C.
McGowan, Henry Earl, VI, '22 (B.T.E.). Instructor, Lowell High School, Lowell, Mass.
Mackay, Stewart, III, '07 (D). Assistant Professor of Textile Design, Lowell Textile School, Lowell, Mass.
McKenna, Hugh Francis, IV, '05 (D). Chicago Manager, United Indigo and Chemical Company, Ltd., 218 West Kinzie Street, Chicago, Ill.
McKinstry, James Bradley, II, '25 (D). Assistant Superintendent, Cordaville Woolen Company, Cordaville, Mass.
MacPherson, Wallace Angus, III, '04 (D). Designer, Wuskanut Mills, Inc., (S. Slater & Sons), Farnumsville, Mass.
Macher, Henry, II, '23 (D). Industrial Research Work, Garfield Worsted Mills, Garfield, N. J.
Mahoney, George Stephen, VI, '22 (B.T.E.). With the Franklin Cotton Mill Company, Cincinnati, Ohio.
Mailey, Howard Twisden, II, '08 (D). Assistant Superintendent, Worsted Department, Pacific Mills, Lawrence, Mass.
Manning, Frederick David, IV, '10 (D). Planning Department, Pacific Print Works, Lawrence, Mass.
Marcoglou, Aristides Sawa, VI, '22 (B.T.E.). 15 Abdine Street, Cairo, Egypt.
Marinel, Walter Newton, I, '01 (D). Automobile Repairing, North Chelmsford, Mass.
Marshall, Chester Stanley, II, '22 (D). Salesman, Dupont Rayon Company, 31 North 6th Street, Reading, Pa.
Martin, Harry Warren, IV, '11 (D). Divisional Manager, Hood Rubber Company, Watertown, Mass.
Mason, Archibald Lee, VI, '09 (D). With Merrimack Woolen Company, Dracut Mass.
Mason, Philip Edwin, IV, '26 (B.T.C.). Salesman, Watson Park Company, 165 High Street, Boston, Mass.
Mather, Harold Thomas, VI, '13 (D). Inspector, Associated Factory Mutual Fire Insurance Companies, Boston, Mass.
Mathieu, Alfred Jules, II, '20 (D). Superintendent of Combing, French Worsted Company, Woonsocket, R. I.
Matthews, Elmer Clark, II, '17 (D). Superintendent, Thermo Mills, Inc., West Sand Lake, N. Y.
Mauersberger, Herbert Richard Carl, III, '18 (D). Chief Assistant with James W. Cox, Jr., Textile Engineer, 320 Broadway, New York City.
Mazer, Samuel, IV, '26 (B.T.C.). In business, Wilber Skein Dyeing Company, Hyde Park, Mass.
Meadows, William Ransom, I, '04 (D). Cotton Registrar and Member of Chicago Board of Trade, Chicago, Ill.
Meek, Lotta, IIIb, '07 (C). See Parker, Mrs. Herbert L.
Merchant, Edith Clara, IIIb, '00 (C). Art Supervisor, Lowell, Mass.
Merrill, Allan Blanchard, IV, '11 (D). Development Engineer, B. F. Goodrich Rubber Company, Akron, Ohio.
Merrill, Gilbert Roscoe, VI, '19 (B.T.E.). Assistant Professor of Textiles, Lowell Textile School, Lowell, Mass.
Merriman, Earl Cushing, II, '07 (D). Died September 30, 1918.
Midwood, Arnold Joseph, IV, '05 (D). Salesman, Dyestuffs Corporation of America, 281 Franklin Street, Boston, Mass.
Miller, Joshua, VI, '24 (B.T.E.). Assistant Technologist, Bureau of Standards, Washington, D. C.
Minge, Jackson Chadwick, I, '01 (C).
Mirsky, Leon Robert, II, '19 (D). 229 West 97th Street, New York City.
Mitchell, Charles Alvah, II, '24 (D). Production Department, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.

Moller, Ernest Arthur, II, '22 (D). Assistant Sales Manager, the Flintkote Company, 809 Park Square Building, Boston, Mass.
Molloy, Francis Henry, II, '16 (D). Assistant Designer, Assabet Mill (American Woolen Company), Maynard, Mass.
Moore, Edward Francis, II, '25 (D). Assistant Superintendent, Worsted Department, Rockford Mitten and Hosiery Company, Rockford, Ill.
Moore, Everett Byron, I, '05 (D). President, Chadbourne & Moore, Inc., Chelsea, Mass.
Moore, Karl Remick, IV, '11 (D). Chemical Engineer, Stillwater Worsted Mills, Harrisville, R. I.
Moore, William Joseph, IV, '21 (B.T.C.). Chemist, Pacific Mills, Lawrence, Mass.
Moorhouse, William Roy, IV, '01 (D). Manager, Domestic Sales, National Aniline and Chemical Company, Inc., 113 High Street, Boston, Mass.
Morrill, Howard Andrew, VI, '16 (D). 116 North Street, Saco, Me.
Morris, Merrill George, IV, '21 (B.T.C.). Overseer of Dyeing, Joseph Wild & Co. (Nassau Felt Mills), Brooklyn, N. Y.
Morrison, Fred Clifton, I, '03 (D). Died August 21, 1919.
Morrison, Haven Asa, IV, '25 (B.T.C.). Colorist, National Aniline and Chemical Company, 113 High Street, Boston, Mass.
Mullaney, John Francis, VI, '20 (B.T.E.). Salesman Saco-Lowell Shops, Newton Upper Falls, Mass.
Mullen, Arthur Thomas, II, '09 (D). Superintendent, Mayo Woolen Mills Company, Millbury, Mass.
Munroe, Sydney Philip, I, '12 (D). Southern Manager, Ralph E. Loper & Co., Greenville, S. C.
Murray, James, IV, '13 (D). Chief Chemist, Appleton Coated Paper Company, Appleton, Wis.
Murray, James Andrew, II, '10 (D). Treasurer, Murray-Sinclair Company, Inc., 144 Commercial Street, Boston, Mass.

Najar, G. George, IV, '03 (D). Overseer of Dyeing, Monument Mills, Housatonic, Mass.
Nary, James Anthony, II, '22 (D). Manager, Chicago Testing House, United States Testing Company, Inc., Chicago, Ill.
Nelson, Roy Clayton, II, '21 (C). Designer, Assabet Mills, Maynard, Mass.
Nelson, Russell Sprague, VI, '22 (B.T.E.). Production Department, Draper Corporation, Hopedale, Mass.
Neugroschl, Sigmond Israel, I, '21 (D). Chemist, Joe Lowe Company, Los Angeles, Calif.
Newall, John Douglas, IV, '09 (D). Divisional Superintendent, Arnold Print Works, North Adams, Mass.
Newcomb, Guy Houghton, IV, '06 (C). Assistant Sales Manager, Dyestuff Department, E. I. du Pont de Nemours & Co., 9132 du Pont Building, Wilmington, Del.
Neyman, Julius Ellis, IV, '15 (B.T.D.). Furniture Dealer, Neyman Furniture Company, 197–199 Middlesex Street, Lowell, Mass.
Nichols, Raymond Elmore, VI, '10 (D). Chief Draftsman, H. E. Fletcher Company, West Chelmsford, Mass.
Niven, Robert Scott, VI, '12 (D). Turbine Drafting Department, General Electric Company, Lynn, Mass.
Nostrand, Mrs. William L. (Conklin, Jennie Grace), IIIb, '05 (C). 35 87th Street, Bay Ridge, Brooklyn, N. Y.

O'Brien, Philip Francis, II, '15 (D). Instructor, New York Textile High School, New York City.
O'Connell, Clarence Edward, IV, '11 (D). Dyer, National Aniline and Chemical Company, Buffalo, N. Y.
O'Connor, Lawrence Dennis, VI, '17 (D). With Beggs & Cobb, Winchester, Mass.
O'Donnell, John Delaney, I, '04 (C).

O'Hara, William Francis, IV, '04 (C). Superintendent, National Oil Products Company, Harrison, N. J.
Olson, Carl Oscar, II, '24 (D). With Talbot Mills, North Billerica, Mass.
Orr, Andrew Stewart, IV, '22 (B.T.C.). With Cherry & Webb, Lowell, Mass.
Othote, Louis Joseph, I, '23 (D). Designer and Styler, T. Holt Haywood 65 Leonard Street, New York City.

Palais, Samuel, IV, '18 (B.T.C.). Assistant Manager, Durrel Company, 1 Beacon Street, Boston, Mass.
Parker, B. Moore, I, '01 (D). Died December 11, 1918.
Parker, Everett Nichols, I, '05 (D). President, Parker Spool and Bobbin Company, 27–53 Middle Street, Lewiston, Me.
Parker, Harry Carmi, III, '00 (C). 142 Berkeley Street, Boston, Mass.
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Perkins, Joshua Dean, III, '08 (D). Overseer, Amoskeag Manufacturing Company, Manchester, N. H.
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Plummer, Elliot Barton, IV, '13 (D). Died January 14, 1919.
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Reynolds, Fred Bartlett II, '08 (D). Purchasing Agent, M. T. Stevens & Sons Company, North Andover, Mass.

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Roche, Raymond Vincent, IV, '12 (D). Died September 10, 1926.

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Savery, James Bryan, II, '23 (D). In Designing Department, Berkshire Woolen Company, Pittsfield, Mass.

Sawyer, Joseph Warren, IV, '15 (B.T.D.). Died May 6, 1926.

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Wilson, Walter Ernest Hudson, I, '04 (C). Deceased.
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Wood, James Carleton, IV, '09 (D). Sales Representative, R. T. Vanderbilt Company, New York City.
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Wu, Tsung-Chieh, VI, '25 (B.T.E.).

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A TENTATIVE STRENGTH STANDARD FOR TWO-PLY COTTON YARNS

This bulletin is an abstract from a thesis conducted at the Lowell Textile School during 1925 and 1926, by Mr. Francis C. Kennedy. The subject for the thesis was suggested by the late Professor Stephen E. Smith of the Department of Cotton Manufacture and the study was made under his supervision. It was a study of the breaking strength of commercial two-ply yarns.

This study does not pretend to set up a permanent standard for two-ply yarns because there were not enough yarns tested to consider the figures conclusive. However, it is offered as a starting point along the path of standard strengths for two-ply yarns. Any comments or suggestions, that any reader cares to make, will be gratefully received.

Object

The object of the thesis was to establish if possible, a standard table for the breaking strength of two-ply cotton yarns, similar to the Draper Table for the breaking strength of single cotton yarns.

Mills manufacturing two-ply yarns were requested to cooperate by submitting samples of their production. Twenty mills sent in thirty-four samples, varying from 16/2 to 100/2.

Procedure

A skein of 120 yards was reeled from each bobbin, (five bobbins per set) using a one an one-half yard cotton yarn reel. This skein with a shorter length was conditioned at 70 degrees Fahrenheit and 65 per cent relative humidity for four hours. The skein was used for a strength test and for a size test. The shorter length was used for single thread tests. A Scott tester was used for the skein tests while a Schopper tester was used for the single thread tests. All tests for strength were made with the lower jaw traveling 12 inches per minute. The skein break was recorded in pounds; the single strand break was recorded in grains.

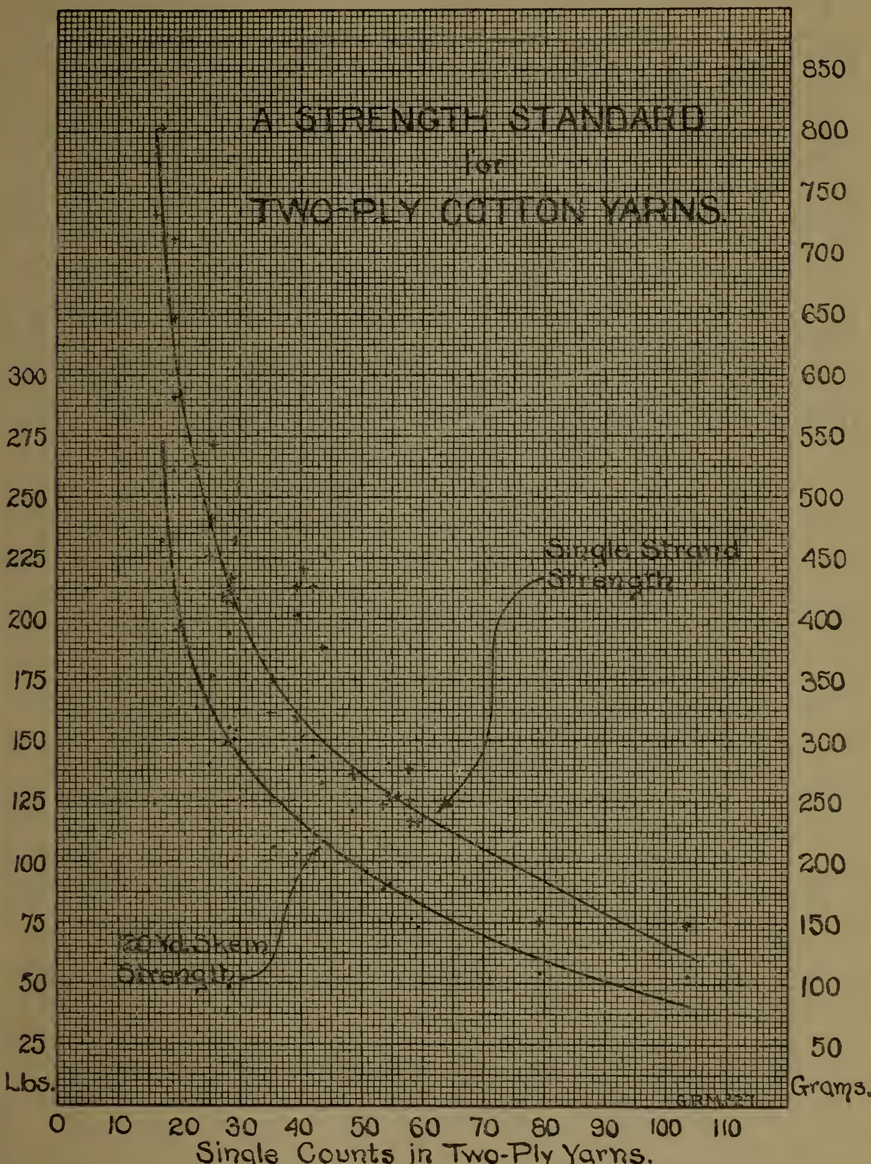
BREAKING STRENGTHS OF TWO- PLY YARNS

Counts		Break		Counts		Break	
Nominal	*Actual Equivalent*	*Skein Pounds*	*Strand Grams*	*Nominal*	*Actual Equivalent*	*Skein Pounds*	*Strand Grams*
2/16*	2/16.1	124.2	733.3	2/36	2/35.6	106.2	350.2
2/17*	2/17.2	232.6	803.9	2/40	2/39.2	102.8	313.6
2/20	2/19.6	266.0	646.4	2/40	2/39.4	146.0	426.4
2/20	2/19.2	260.4	711.6	2/40	2/39.6	118.4	402.0
2/20	2/19.7	195.0	583.2	2/40	2/42.0	143.0	426.8
2/23	2/23.0	166.7	525.9	2/40	2/40.1	152.0	442.0
2/24	2/25.0	140.0	452.3	2/45	2/43.6	132.0	376.8
2/26	2/25.7	177.0	544.3	2/50	2/48.4	121.0	273.4
2/26	2/25.2	176.0	483.6	2/54	2/53.4	88.4	247.1
2/28	2/27.3	148.0	419.4	2/56	2/54.8	91.0	254.8
2/28	2/28.0	149.4	416.4	2/58	2/57.9	85.0	234.4
2/28	2/28.6	148.0	424.3	2/58	2/56.0	90.6	253.9
2/28.5	2/28.3	155.5	436.6	2/60	2/59.2	72.9	232.9
2/30	2/29.4	154.1	465.0	2/60	2/57.9	84.8	277.0
2/30	2/30.0	208.4	510.5	2/60	2/58.0	76.6	251.0
2/30	2/29.0	150.8	412.4	2/80*	2/79.2	54.0	151.0
2/35	2/35.0	100.4	322.5	2/100*	2/103.4	52.3	148.0

Observations and Conclusions

The accompanying plot of these values shows the strength of the ply yarns plotted vertically against the count of the single yarns, which compose the ply yarn, plotted horizontally. The scale at the left indicates the pounds at which the 120 yards skeins broke. The dots indicate the various points. The

*As there are but few points for the coarser yarns and only a few for the very fine yarns the two extremes of the table can not be considered as representative as the range from 20's to 60's.


A STRENGTH STANDARD
for
TWO-PLY COTTON YARNS.
Single Strand
Strength
120 Yd. Skein
Strength
300
275
250
225
200
175
150
125
100
75
50
25
Lbs.
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
Grams.
0
10
20
30
40
50
60
70
80
90
100
110
Single Counts in Two-Ply Yarns.

scale at the right indicates the grams at which the single strands broke. The crosses indicate the various points.

The similarity of these two curves in indicates a possible constant ratio between the strength of the skein and the strength of the single strands. Except for the first sample the yarns show a reasonably constant difference, which for the entire group shows that the skein break averages 155 times the single strand break.

As a matter of theory a very low count yarn would break at a high point. As the yarn count became finer it would break at a lower and lower point until a very, very fine yarn would break at a very low point. This would be a curve of the hyperbolic type.

The curves plotted here seemed of this general class and as the skein break is the more commonly used an attempt was made to determine the equation which the skein break curve represented. Using the general equation $y = ax^b$, a solution was made for a and b. Y was the strength in pounds of the skein break. X was the actual equivalent single count found. By solving the value "a" was found to be 2440, while the value "b" was found to be -.834. This made the equation $y = \frac{2440}{x^{834.}}$ Plotting this curve to the scales used in the plot shown here showed the two curves to be practically coincident, from the single counts of 20's to 70's.

Another interesting feature in connection with this study was that the values of the two-ply skein break curve are very close to two and one half times the values given in the old Draper standard for Warp Yarns.

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CALENDAR.

1927.

September 29, Thursday	Registration.
October 6, Thursday	Registration.
October 10, Monday	Opening of evening school.
November 24, Thursday November 25, Friday	Thanksgiving recess. No classes.
December 16, Friday	End of first term.

1928.

January 2, Monday	Opening of second term.
March 9, Friday	Closing of evening school.
April 5, Thursday	Graduation.

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EVENING CLASSES.

GENERAL INFORMATION.

Entrance Requirements.

All applicants to the evening classes must understand the English language and simple arithmetic. Those who are graduates of a grammar or high school are admitted upon certificate. Those who cannot present such a certificate are required to take examination in the subjects of English and arithmetic. In the examination in English a short composition must be written on a given theme, and a certain amount must be written from dictation. In the examination in arithmetic the applicant must show suitable proficiency in addition, subtraction, multiplication, division, common and decimal fractions, percentage, ratio and proportion. Opportunity to register or to take these examinations is offered each year, generally on the Thursday evenings of the two weeks previous to the opening of the evening school.

Registration.

Before entering the class a student must fill out an attendance card, which can be obtained at the office or from the instructors in the various departments.

Any student who has filed an attendance card and who wishes to change his course must notify the office before making the change.

Sessions.

The evening classes commence the second Monday of October and continue for twenty-one weeks. The school is open on four evenings each week during the period mentioned, except when the school is closed for holiday recesses.

Supplies.

Students must provide their own books, stationery, tools, etc., and pay for any breakage or damage that they cause.

Students' supplies will be sold from the co-operative store every evening school night from 6.45 to 8.15 P.M.

Fees and Deposits.

All evening courses are free to residents of Lowell. To those outside of Lowell the fee is $10 per year for *each course of two nights per week.* Students taking two courses or attending courses requiring more than two nights per week are required to pay $15 per year for three nights and $20 for four nights.

All fees and deposits must be paid in advance.

All students, whether from Lowell or not, taking Course 411, Chemistry and Dyeing Department, are required to make a deposit at the commencement of the course — $5 for first-year students, and $10 for second-year students. A deposit of $10 will be required of all students taking Course 412, 413 or 414. This is to cover the cost of laboratory breakages, chemicals, apparatus, etc., and at the end of the year any unexpended balance is returned, or an extra charge made for the excess breakage.

Every student who takes the chemistry and dyeing course must check up his desk with the instructor of that department when he leaves the school. Any student not doing so will be charged 50 cents.

All students taking Machine-shop Practice will be required to make a deposit of $5. Any unexpended balance remaining at the end of the year will be returned to the student.

Report of Standing.

A report of standing covering the year's work is sent to all students who attend the entire year and take the necessary examinations.

Certificates.

The courses of the evening school are varied and arranged to meet the special needs of those engaged in the industry. They vary in length from one to four years, and at the completion of each course the certificate of the school is awarded, provided, however, that the student has been in attendance in the course during the year for which the certificate is granted.

GENERAL EVENING COURSES.

The object of these courses is to give young men of ambition an opportunity to obtain instruction in all the branches of science that are allied with their daily work. For example, one who is employed as a weaver in a textile mill may, by means of the courses in manufacturing, obtain knowledge of the manufacture of yarn, the production of a design, and the methods of finishing a fabric, as well as the manner of its weaving or knitting. In like manner the dyer may augment his knowledge of the chemicals and materials he is daily handling. The engineer and machinist may acquire a knowledge of the mathematics, science of mechanics, electricity and drawing that underlie all the work of an engineer.

It is recognized that the interests of such students lie in a particular field of industry, and these courses are designed to bear directly upon the special line, and supplement, as far as possible, the practical work in which the student is engaged during the day.

In a word, any man having a common school education and the ambition to advance in his line may now secure a broad and comprehensive training in the subjects which will be of vital importance to him in obtaining the goal of his ideal.

A description of all courses follows.

COTTON DEPARTMENT.

110. Cotton Yarns — 3 Years.

The *first year* work in cotton yarn manufacture consists of a study of cotton and its preparation for market, followed by a study of picking, carding and combing.

The work in the picking, carding and combing classes consists of lectures on these operations combined with problems that are peculiar to each operation such as the drafts used and the production of each process as well as the amounts of waste made. Special consideration is given to the adjustment and care of these machines and some laboratory demonstration is used to show the manner of adjusting machines for the purpose of controlling the weight of the product, the amount of work done in a day and the control of waste.

Cotton. — Before taking up the details of manufacturing cotton into yarn, a careful study of its physical characteristics is made. The geographical distribution of the areas producing commercial cottons is explained and the characteristics of the cottons produced in each are studied. A general explanation of the cultivation and harvesting of cotton is made, especially emphasizing the effect of agricultural factors on the cotton fiber and how these may serve to complicate manufacturing problems.

The ginning of cotton is considered, showing the yield of lint, the uses of cotton seed and the various types of gins and what cottons are commonly ginned on each.

The intricate system of buying and selling cotton is studied to illustrate the problems a mill may meet in procuring cotton. In this connection, special emphasis is placed on the classification of cottons by staple and by grade.

Opening and Picking. — Instruction in the preliminary operation of opening and picking covers the mechanical construction of the machines, their parts and adjustments, as fully as the manufacturing results accomplished by the machines. This includes such construction details as evener, lap measuring and safety stop motion, grids, cleaning trunks and beaters, also operation details which involve the adjustment of waste, drafts and character of laps. Some time is devoted to mixing in its various phases, showing in addition to improvement in uniformity of the product, how cottons are mixed to obtain definite average prices and how different percentages of color may be obtained by mixing, especially on the pickers.

Carding. — The process of carding is considered one of the most important, and proper time is devoted to the construction and operation of cards that the student may be familiar with the various parts of the card and the function and design of each. The construction and application of card clothing, as well as the methods of grinding, form a part of the work. Some time is given to a discussion of the waste made in carding, the regulation of the amounts of each made and the calculation of the percentages. New and special attachments for various purposes are brought to the attention of the class, illustrating possible ways of improving carding conditions.

Combing. — The preparation of card sliver for combing, by means of the sliver lapper and ribbon lapper is thoroughly considered. The combing operation itself is studied in considerable detail, emphasizing the general object and operations in combing and the specific means employed by various types of combs in performing the operation. The calculations in this connection involve the drafts and doublings necessary to produce the proper lap for the comb, the proper comb drafts, and the determination of the per cent of noil produced.

The *second year* work includes a study of the drawing and roving processes and the calculations that accompany these operations. It consists also of lectures on the machines and demonstration of their adjustment, showing roll setting, draft and twist control, builder adjustment, spacing coils on the bobbin, and tension control.

Drawing. — Under this head is taken up the theory of doublings and their effect upon the quality of roving and yarn. Like previous and subsequent processes the machine construction forms an important part of the work. Proper stress is paid to such subjects as stop motions, drawing rolls and their covering, cleaners and evener motions.

Roving Processes. — Under this head are studied the various machines known as the slubber, intermediate, fine and jack fly frames. The relative motion of the various parts of these machines is so complex that a good opportunity is here presented to fix in the student's mind the application of certain mechanical principles that are used in other departments and upon other machines in the manufacture of textile material. With each process of yarn manufacture are explained the systems of sizing and numbering, and under this head are taken up both the metric and English systems.

During the *third year* the time is devoted to a study of ring and mule spinning, spooling, winding, twisting and reeling. As in previous years, the work consists of lectures and demonstration on the machines. During this year there is also some work done on the combing machine, particularly in the nature of its adjustment. In addition to these subjects, there is some work done in the way of planning the organization of a cotton mill with a view to showing drafts, speeds, productions and number of machines of each kind necessary for the production of a given amount of a certain yarn.

Ring Spinning. — The consideration of spinning yarn by the ring frame method involves a knowledge of the uses to which the yarn is to be put, subsequent methods of handling that proper roving may be selected, suitable amounts of draft and twist provided, correct size of rings and travelers selected, and building motions suitably adjusted. Yarn defects are studied with reference to the cause and remedy, necessitating references to many of the earlier operations.

Mule Spinning. — This method of spinning is very different from that of the ring frame, and the mechanical details are more complicated. The student is furnished with new means of producing yarns, and can compare the relative advantage of each method. A thorough understanding of mule spinning is perhaps more a study of mechanical motions and their functions. This results almost invariably in assisting the student to understand previous processes and machines better because of his work on the mule. It is the object to make clear to the student's mind the principles underlying the construction and operation of the parts that control the drawing, twisting, backing off, winding, together with such special motions and devices as are used upon the modern mule.

Spooling and Winding. — The discussions under this head cover the treatment of single yarns, ring or mule spun, in preparation for twisting, comparing the relative merits of spooling with multiple winding on tubes, and beaming for special twisters. Winders are also considered as a means of preparing yarn packages for sale yarns.

Twisting. — Because of the similarity to ring spinning, the emphasis is more on the manufacturing part of the work, although there are a few peculiar features of a mechanical nature. The twisting of various regular ply yarns, the making of numerous fancy yarns and the principles underlying the production of unlimited patterns is taken up here. The use of special twisters and other apparatus for cords and ropes is considered at this point.

112. Cotton Manufacturing — 4 Years.

The Cotton Manufacturing course is designed to give a student a broad knowledge of the manufacture of cotton cloth. To do this he is required to spend three years in the department of cotton yarns, studying cotton and its conversion into yarn. A student taking this course also spends two years in weaving, one on plain and one on dobby weaving. Three years are spent in a study of the art of designing a fabric and the analysis of fabric already constructed. One year is spent in a study of the processes involved in finishing cotton fabrics. For detailed description, see subjects under Yarns, Weaving, Designing and Finishing.

WOOLEN AND WORSTED DEPARTMENT.

210. Worsted Yarns — 2 Years.

During the *first year* instruction consists of a lecture course on the various kinds of wool fibers, trade terms, sorting, scouring, carbonizing, etc., also a course in carding and the calculations involved in the mechanism of the machines, and a course covering gilling and combing and the processes of top making. The *second year* is devoted to detail study of the English and French systems of worsted yarn manufacture.

211. Woolen Yarns — 2 Years.

During the *first year* instruction consists of a lecture course on the various kinds of wool fibres, trade terms, sorting, scouring, carbonizing, etc., also of a course on carding. The *second year* continues the instruction on carding and then takes up a course on the mule and woolen yarn spinning.

Raw Materials. — A study of raw materials which enter into the manufacture of woolen or worsted yarns, or are made into yarns by processes similar to those employed in the manufacture of woolen and worsted yarns, would include silk, mohair, alpaca, vicuna, cashmere, camel's hair and cotton. In connection with these are considered shoddy, noils and extracts.

Wool Sorting. — Familiarity with the various grades and kinds of wool is obtained by lecture. The various characteristics and properties are explained, as are also trade terms, such as picklock, XXX, XX, ½-blood, ⅜-blood, ¼-blood, delaine, braid, etc. Some skill is acquired in the estimation of shrinkage and in judging the spinning qualities.

Wool Scouring. — The object of scouring and the methods employed are explained, and this involves the consideration of the soaps and chemicals used in washing; also the waste products and their utilization. A demonstration of a commercial quantity of wool is scoured by machines that are made similar in operation to regular commercial machines. A study is made of the effect of the hardness of water upon soap. At the same time the use of driers, their operation and regulation, is taken up, and the methods of carbonizing wool, noils, burr waste, rags, etc., are studied and explained.

Burr Picking, Mixing, Oils and Emulsions. — The use of burr pickers in cleaning wool and the use of mixing pickers in making color blends is covered by lecture and demonstration. Under the subject of oil and emulsions are taken up the characteristics of various oils and the means employed to test them.

This work is taken only by those students who are pursuing the Woolen Manufacturing Course.

Carding. — The different systems of carding wool, depending on whether it is to be made into woolen or worsted yarns, are fully explained, as is also the construction, setting and operation of cards. A part of this work consists of a study of card clothing, its construction, application and grinding.

Woolen Mule. — The student studies thoroughly the operation of the mule as a whole, and acquaints himself with the various principal mechanisms, as, for example, the backing off and winding motions, the quadrant, builder-rail, faller regulation, etc.

Top Making and Combing. — This branch takes up, besides the carding of the wool on a worsted card, the preparing processes, backwashing, also gilling of the stock before and after combing. The construction of the gill boxes and combs is studied by lectures. Later, quantities of stock are made into top and then into yarn.

The Noble, Lister and French combs are studied, and the various calculations to determine draft, noiling, productions, etc., are made.

Drawing and Spinning. — The equipment in the laboratory offers opportunity to make worsted yarn by either the Bradford or open drawing system or by the French system. The process includes the various machines in the successive steps of making Bradford spun yarn, and the functions of the different machines are studied. In the latter, or French system, the stock is run through the drawing machines, and the roving spun into yarn on the worsted mule. The same method of studying the mechanism and operations of these machines is followed as in the case of previous methods of instruction. The student by pursuing this course can compare the different methods of yarn manufacture and note the results of each.

With the instruction in spinning by the Bradford system is given work on the twisters and the effects that may be produced.

214. Woolen Manufacturing — 4 Years.

215. Worsted Manufacturing: Bradford System — 4 Years.

216. Worsted Manufacturing: French System — 4 Years.

These courses are arranged to give those engaged in the manufacture of woolens and worsteds instructon in the various branches of the work. It embraces a study of wools and allied fibers and the manner of manipulating from fibers to finished fabric, including all the processes of yarn manufacturing, weaving, designing and finishing. The instruction given in these three courses is the same throughout the four years with the exception of that given in yarns.

During the *first year* lectures are given on wool fibers and the preliminary processes of their conversion into yarns, calculations of the mechanism of the machines and elementary instruction in cloth designing and analysis.

During the *second year*, students selecting the Woolen Manufacturing Course follow a course in carding and mule spinning and continue the first year work in design and cloth analysis. Students taking either of the Worsted Manufacturing courses continue their work in yarns by studying gilling, combing and the processes of top making. More time is given this year to design and cloth analysis.

In the *third year* students continue their instruction in yarn manufacture, design and cloth analysis, and add the subject of weaving to the course.

During the *fourth year* instruction is given in weaving and finishing.

TEXTILE DESIGN AND WEAVING DEPARTMENT.

311. Cotton Design — 3 Years.

During the *first year* instruction is given in elementary designing, starting with all the foundation weaves which may be used in fabrics such as the plain weave, rib weaves, basket weaves, twill weaves, satin weaves, granite weaves, etc. Combination and derivative weaves are made up from the aforesaid weaves. Fancy and figured weaves, in most cases originated by the student, are produced. Color effects, which are so essential in fabrics, obtainable from the different weaves, as stated above, in which the color arrangement of warp and filling create the pattern, are thoroughly considered. Not only the designing but also harness drafting and the making of dobby chains for any type of weave is taken up.

Cloth analysis is considered in conjunction with designing, as a designer must know the kind of a fabric he is designing, what material and what size of yarns are to be used, and how heavy and costly the cloth is to be. The various topics discussed are the sizes or counts of yarns made from all kinds of fibers, such as cotton, woolen, worsted, silk, rayon, jute and yarns made of other vegetable fibers. Their relative length to the pound is determined in the single, two or more ply, mixed yarns, novelty yarns and fancy yarns, in the American or English system. The same is given in the metric system. Problems involving the take-up of yarns in the weaving and finishing processes are given. Samples of cloth are picked apart to determine their weaves and general construction.

In the *second year* cloth analysis and design are combined in lecture and practice, starting with plain and leading into the more fancy cotton dobby fabrics. A great variety of samples of cloth are used in class work to determine ends and picks per inch, shrinkage in warp and filling, and the number of reed and reed widths

necessary for eventual reconstruction. The yarn numbers of warp and filling are determined by aid of fine balances. The amount of warp and filling necessary for a piece of goods is calculated and the weight of a whole piece as well as the number of yards per pound are determined.

In the *third year* more elaborate cloths are considered, both in designing and analysis, cloths in which extra warp or extra filling, or both, are used. Warp backed, filling backed, double, triple or more plied fabrics are taken up, such as marseilles, quiltings, piqué, suspenders, narrow webbings, velveteens, fancy velveteens, velvets, corduroys, Bedford cords, plushes, leno, in fact, anything a student may suggest which might help him in his work.

312. Woolen and Worsted Design — 3 Years.

This course covers the design and analysis of standard woolen and worsted fabrics and is intended for those who wish to specialize in this branch of textile fabric manufacture. Special and fancy fabrics are studied to the extent that time will permit.

During the *first year* instruction is given in the subject of classification of fabrics, use of point or design paper, plain fabrics, intersection, twills and their derivation, sateen, basket and rib weaves, checks and stripes, fancy weaves, including figured and colored effects; producing chain and draw from design, and *vice versa;* extending and extracting weaves.

The analysis of samples is taken up in a systematic manner, illustrating the various cloth constructions for the purpose of determining the design of the weave and the amount and kind of yarns used, and forms the basis of calculation in the cost of reproducing any style of goods. The various topics discussed are reeds and setts; relation and determination of counts of cotton, woolen, worsted, silk and yarns made from the great variety of vegetable fibers; grading of yarns, folded, ply, novelty and fancy yarns; application of the metric system to yarn calculation; problems involving take-up, average counts, determination of counts of yarn, and weight of yarn required to produce a given fabric.

During the *second year* instruction is given in cotton warp goods, blankets, bath robes, filling reversible, extra warp and filling backs, figured effects produced by extra warp and filling, double cloths and plaid backs.

The analysis work follows as closely as possible the type of fabrics taken up in the designing and the reconstruction of these fabrics with the consideration of their shrinkages and composition.

In the *third year* instruction is given in multiple fabrics, chinchilla, Bedford cords, crepon, metalasse and imitations, double plains, meltons, kersey, plush and suitings. At this time also is taken up the construction of designers' blankets, suggestion cards, and the construction of samples.

The construction of new fabrics from theoretical viewpoint together with the construction from suggestion cards is taken up. In connection with this work instruction is given in making cost estimates for both woolen and worsted fabrics.

314. Cotton Weaving — 1 Year.

The course in Cotton Weaving covers instruction on plain looms, Draper Automatic and Stafford Automatic looms. It includes instruction on the construction of shedding and picking motions, take-up and let-off motions together with the operation of the magazines and hoppers and methods of changing shuttle and bobbin. A study is also made of the preparation of warps, beaming, sizing and drawing-in. The Crompton and Knowles Automatic Towel Looms and the various types of box looms, including chain building and work on multipliers, are also considered in this course.

315. Woolen and Worsted Weaving — 2 Years.

This course includes instruction on the Crompton and Knowles loom and takes up general construction, head motions, take-up, let-off, filling stop motion, etc. The preparation of warps, wet and dry dressing, is given in connection with this course.

316. Dobby and Jacquard Weaving — 1 Year.

This course considers the various types of Jacquard heads and dobbies, which includes single cross border dobbies and leno attachments on double lift dobbies,

handkerchief motions, leno weaving, center selvedge motions, filling changing looms, oscillating reeds, lappet motions, various shaker motions, towel and other pile cloth weaving. The course on Jacquard looms includes general construction, card cutting, lacing, repeating, and fixing.

317. Freehand Drawing — 3 Years.

In the course in freehand drawing, instruction is given in the drawing from models, casts and designs. Work is taken up in charcoal and also in colors. This course has appealed to many young women of the city, and it is believed that this is a most fortunate opportunity for both young women and young men of Lowell to acquire the elements of artistic designing.

CHEMISTRY AND DYEING DEPARTMENT.

Hardly any branch of applied science plays so important a part in our industrial world as chemistry. Many large mills employ the chemist as well as the dyer, and with the great progress which is being made in the manufacture and application of dyestuffs, a basic knowledge of chemistry becomes an absolute necessity to the dyer. Within a comparatively short distance from Lowell are establishments employing men who require some knowledge of chemistry but who may not necessarily use dyes. Some find a knowledge of analytical chemistry helpful in their everyday work.

To meet these varying needs of our industrial community, the school offers a two-year course in general chemistry, organic and inorganic, which may be followed by any one of three courses, viz., textile chemistry and dyeing, analytical chemistry, and textile and analytical chemistry. In order to take Courses 412, 413 or 414, candidates must have a certificate from Course 411, or show by examination or approved credentials that they have taken the equivalent of the work covered by this course.

411. Elementary Chemistry — 2 Years.

General Chemistry, including Inorganic and Organic.

Qualitative Analysis.

One lecture and one Laboratory Period per week in General Chemistry the first year, continued three nights a week during the second year, when the Elementary Organic Chemistry and Qualitative Analysis is completed.

Instruction in Elementary Chemistry extends through two years, and includes lectures, recitations and a large amount of individual laboratory work upon the following subjects: —

Theoretical Chemistry. — Chemical action, chemical combination, combining weights, atomic weights, chemical equations, acids, bases, salts, Avogadro's law, molecular weights, formulæ, valence, periodic law, etc.

Non-metallic Elements. — Study of their occurrence, properties, preparation, chemical compounds, etc.

Metallic Elements — Study of their occurrence, properties, metallurgy, chemical compounds, etc.

The students take up, as thoroughly as time will permit, the qualitative detection of the more common metals and non-metals, with practical work.

This work, although necessarily elementary, is intended to prepare the student to study more understandingly the manufacture of dyestuffs and coal tar colors in the more advanced courses which follow.

During the first year of the Elementary Chemistry course most of the time is devoted to the non-metals and theoretical chemistry, and the laboratory work covers briefly the non-metals.

During the second year the classroom work is upon metals and the hydrocarbons and their derivatives, and the laboratory work consists entirely of Qualitative Analysis. While this course is necessarily taken up in an abbreviated and elementary manner, it is so arranged that the students may become familiar with the separations and the detections of the common metals and acids. This course is also preliminary to the work given in Analytical Chemistry.

412. Textile Chemistry and Dyeing — 3 Years.

Lectures in Textile Chemistry and Dyeing.

Laboratory Work in Dyeing.

Covered by 40 lectures and two nights of laboratory work per week.

The outline of the lecture course given in Textile Chemistry and Dyeing is as follows: —

Technology of Vegetable Fibers. — Cotton, linen, jute, hemp, china grass. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Animal Fibers. — Wool, mohair, silk. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Artificial Fibers. — Study of the various forms of artificial silk, the process of manufacture, their properties and action with chemicals, acids and heat.

Operations preliminary to Dyeing. — Bleaching of cotton and linen; wool-scouring; bleaching, fulling and felting of wool; carbonizing; silk-scouring and bleaching; action of soap.

The bleaching of cotton is studied with description of the various forms of kiers and machinery used; also the action of the chemicals used upon the material, and the various precautions that must be taken in order to insure successful work.

Under this heading is included a study of the reagents used in the emulsive wool-scouring process, and their action upon the fiber under various conditions; also the most successful of the solvent methods for degreasing wool.

Water and its Application in the Textile Industry. — Impurities present methods for detection, their effect during the different operations of bleaching, scouring, dyeing, and printing, and the methods used for their removal or correction.

The important subject of boiler waters is also studied under this heading, with a full discussion of the formation of boiler scale, its disastrous results, and the methods by which it may be prevented.

Mordants and Other Chemical Compounds used in Textile Coloring, and classified as Dyestuffs. — Theory of mordants, their chemical properties and application, aluminum mordants, iron mordants, tin mordants, chromium mordants, organic mordants, tannin materials, soluble oil, fixing agents, leveling agents, assistants, and numerous other compounds not dyestuffs that are extensively used in the textile industry.

Under this heading are included the definitions of various terms and classes of compounds used by textile colorists, such as color lakes, pigments, fixing agents, developing agents, mordanting principles and leveling agents.

Natural Organic Coloring Matters. — Properties and application of indigo, logwood, catechu or cutch, Brazil wood, cochineal, fustic, turmeric, madder, quercitron bark, Persian berries, and other natural dyestuffs that have been used in recent years by textile colorists.

Mineral Coloring Matters. — Under this heading are discussed the properties of such inorganic coloring matters and pigments as chrome yellow, orange and green, Prussian blue, manganese brown, iron buff.

Artificial Coloring Matters. — General discussion of their history, nature, source, methods of manufacture, methods of classification and their application to all fibers.

Besides lectures and recitations upon the subject of Textile Chemistry and Dyeing, practical laboratory work is required. By the performance of careful and systematic experiments the student learns the nature of the various dyestuffs and mordants, their coloring properties, their action under various circumstances, and the conditions under which they give the best results. The more representative dyestuffs of each class are applied to cotton, wool and silk, and each student is obliged to enter, in an especially arranged sample book, a specimen of each of his dye trials with full particulars as to the conditions of experiment, percentage of compounds used, time, temperature of dye bath, etc.

For convenience and economy most of the dye trials are made upon small skeins or swatches of the required materials, but from time to time students are required to dye larger quantities in the full-sized dyeing machines.

413. Analytical Chemistry — 3 Years.

Laboratory Work and Lectures in Quantitative Analysis.

Three nights per week of class-room and laboratory work.

The object of this course is to give the student a general idea of the underlying principles of Analytical Chemistry, with a sufficient amount of laboratory work to enable him to become proficient in performing the ordinary routine analysis of the textile plant. Frequent recitations are held for the discussion of methods and the solution of stoichiometrical problems.

The work covered the first two years is based on Smith's "Quantitative Analysis," and for the advanced work, consisting of the analysis of soap, water, oils, cloth and other materials of particular interest to the textile chemist, special lecture notes and Griffin's "Technical Methods of Analysis" is used as a text.

414. Textile and Analytical Chemistry — 4 Years.

Lectures in Textile Chemistry and Dyeing.

Laboratory Work in Analytical Chemistry.

Combines all lectures in Textile Chemistry and Dyeing with work of Course 413, but does not include any Dyeing Laboratory. Three nights per week.

TEXTILE ENGINEERING DEPARTMENT.

This department has arranged to offer those courses of study which lie at the foundation of all engineering. These are designed to give to those engaged in the mechanical, electrical, and manufacturing departments of mills, factories and other industrial establishments an opportunity to learn something concerning the theory underlying the many practical methods which they use in their daily work. Those subjects for which there is usually a regular demand are listed and described below, but similar and allied courses will also be arranged for provided there is a sufficient demand. In the case of all courses there must be an enrollment of at least ten properly qualified students to warrant giving the subject.

613. Mechanical Drawing — 3 Years.

For one having occasion to make a sketch or detail drawing for the purposes of illustration or instruction, or for one who is daily required to work from a drawing or blue print, the course in Mechanical Drawing is offered. It first lays a foundation of the principles of mechanical drawing, and follows this with two years' work in drawing directly from parts of machines, preparing both the detail and the assembly drawing.

This course is a complete course in drawing and requires two evenings per week for three years for its completion. The work is so planned that at its completion a man shall be thoroughly familiar with the making of a working or shop drawing. After a study of the underlying principles of projections and instruction in penciling, inking, lettering and tracing, the subject of sketching and the making of detail drawings therefrom is especially stressed. The preparation of assembly drawings is finally considered.

614. Machine Shop Practice — 2 Years.

This course offers an opportunity to learn the art of metal working and is equally valuable to the man who already has some knowledge of the methods employed as to one who has no knowledge of the same. Thus it becomes possible for one who may be working at the bench during the day to learn how to operate a lathe or other machine tool, or for a lathe hand to acquire a knowledge of a planer, shaper, milling machine, or grinder. A series of lectures is given on the care and management of tools, tool grinding, and the mechanism of the machines. A man who only has a knowledge of the special machine which he operates may by means of this course become a more intelligent machinist. He should supplement this study with the courses in Mechanical Drawing, and in Mechanics and Mechanism, in order that his training for an all-round machinist or mechanic may be more complete. The time required is two evenings per week.

619. Mechanics and Mechanism — 2 Years.

This is one of the most important of engineering subjects dealing as it does with the principles which underlie the transmission of force and motion through

machines and mechanical devices. Its principles are so fundamental and so widely used in more advanced subjects that the student should not consider himself qualified for further work until he has mastered the principles of this subject.

Beginning with a discussion of such important topics as work, power, horsepower, energy and the like, the student then studies the fundamental mechanical principles which are exemplified by the lever, jackscrew, pulley block, inclined plane, wedge, differential pulley and other similar devices. This is followed by consideration of the simpler relations pertaining to uniform and accelerated motion and the course concludes with a study of pulleys, belting, gears and gearing, as far as time permits. No student should undertake this course who is not thoroughly familiar with elementary mathematics. This subject requires attendance two evenings per week with home problem work and the study of a text book.

620. Mathematics — 2 Years.

This course is designed to permit the student to pursue further by evening study the mathematics of his grammar or junior high school course. It includes algebra, elementary trigonometry, logarithms and slide rule, and requires attendance for two evenings per week. It should be taken by all who intend to study further into engineering subjects. Instruction is largely through problem work in class and at home, and the use of a text book.

Some of the topics treated are —

Elementary algebraic operations of —

- Addition.
- Subtraction.
- Multiplication.
- Division.
- Factoring.
- Fractions.
- Graphical representation.
- Linear equations.
- Radicals.
- Logarithms.
- Slide rule.
- Trigonometry.

621. Strength of Materials — 1 Year.

This interesting subject deals with those important principles whereby the person engaged in machine, engine, mill or building design may ascertain whether the parts are strong enough to carry the forces and loads which the nature of the construction imposes upon them.

The fundamental stresses of tension, compression and shear are first considered, together with the ultimate strength of cast iron, wrought iron, steel, and timber. The practical use of this information is illustrated in the design of bolts, tie rods, columns, wall piers, boiler shells, riveted joints, etc. This is followed by a study of the stresses in and design of beams under various conditions of loading, and the course concludes with a discussion of the torsional stresses and twist in shafts. A knowledge of the principles of Mechanics and Mechanism is highly desirable to a satisfactory understanding of this subject. The time required is one evening per week and the method of instruction is through lectures, recitations, problems, and the use of a text book.

622. Steam — 1 Year.

It is the purpose of this course to study the various methods of heat generation, transmission, and utilization in use at the present day and to learn the theoretical relationships which underlie these processes and transformations.

The instruction covers, so far as time permits, the elements of steam engineering. The topics covered are heat and its measurement, use of steam tables, types of boilers, engines and turbines, boiler and engine room accessories, together with a study of the methods of testing the various types of apparatus. Actual tests on such equipment are made as the size of the class permits. Text book, laboratory and class work, and home problems are the methods of instruction used, requiring an attendance of one evening per week.

623. Direct Current Electricity — 2 Years.

This popular course is planned to cover the fundamentals of direct current circuits and machinery. The lectures on electrical theory are supplemented by laboratory work and the use of a text book and problems. It requires for its completion attendance for two evenings per week and a considerable amount of home study and preparation.

The fundamental properties of electrical and magnetic circuits are studied both in the class-room and laboratory. Other topics include the measurement of resistance, the calculation and measurement of power in direct-current circuits, and the relation between the electrical, heat and mechanical units of energy. A large amount of laboratory and class work is given to make the student familiar with methods of operation, testing and control of direct current machinery.

624. Alternating Current Electricity — 2 Years.

This course is similar to course 623 except that it deals with alternating current circuits and machinery. No student should plan to take this course unless he has previously taken Course 623 or can show that he has had the equivalent. It is also highly desirable that he have a good knowledge of Mathematics as given in Course 620.

The fundamental properties of alternating current circuits are first considered, and is followed by a study of the operation of alternating current machinery. The study of mill illumination and electrical measuring instruments is included in this course. The instruction is given by means of lectures, recitations, and a large amount of laboratory work. An attendance of two evenings per week is required.

FINISHING DEPARTMENT.

In these courses machine work is supplemented by lectures and discussions pertaining to the many finishes given to fabrics. The action of soaps, water, steam, heat and cold upon cloth containing one fiber or combinations of fibers as used in commercial fabrics is carefully studied. These courses also help the finisher to broaden his knowledge of textile fabrics. Attendance is required for two evenings per week.

710. Woolen and Worsted Finishing — 1 Year.

The outline of this course, which is given chiefly by means of lecture work, is as follows: —

Burling and Mending. — Under this head are taken up for consideration the examination of flannel as it comes from the loom; the construction, use and location of the perch; the methods used in marking defects, measuring, weighing and numbering of cloths; also the methods of inspection for fancies, single cloths and double cloths. The object of burling, mending and the types of tables employed, the method of removing knots, runners, etc., the object of back shearing and the use of burling irons, the replacing of missing threads and the importance of sewing as a part of the finishing process, are all considered in detail. The removal of oil and tar spots as well as stains of various kinds is studied.

Fulling. — This branch covers a study of the conditions of the flannel as it comes from the loom, and the influence of oil, etc., upon the procedure. Considerable time is devoted to the various methods of producing a felt, the various types of stocks, and their modifications and development into the present type of rotary fulling mills of both the single and double variety. The details of construction in all machines are carefully taken up and include the design and composition of the main rolls, methods of covering, regulation and means of adjusting the pressure of traps and rolls, and the use and regulation of the various types of stop motion, the different types of stretchers, guide rolls and throat plates.

The theory of felt is taken up and the influence of pressure, moisture, heat, alkali and acid is considered, as well as the hydroscopic and felting properties of different wool fibers. The preparation of the flannel for the mill and the usual methods of determining shrinkages, as well as the various methods of soaping, are given careful attention. The preparation of various fulling soaps and the value of each for the production of various degrees of felt, as well as the determination of the proper amount of alkali for various goods, are carefully studied and demonstrated. The manipulation of the various kinds of goods in the mill, viz., all wool, reworked wools and mixed goods, is studied in classroom and by operation in the laboratory.

The change in weight and strength for each operation is carefully considered, as is also the value of the flocks made in each. A study of the various methods of flocking, such as dry and wet, is considered in both class and machine rooms. In each operation the defects likely to materialize are studied, as well as the cause thereof, and various methods of modifying or lessening them.

Washing and Speck Dyeing. — This branch considers the scouring, rinsing and washing of goods both before and after the fulling process; the various types of washers; and the details of construction, such as suds box, rolls, etc. The theory of scouring, uses of Fullers' earth, salt solutions and sours on the different kinds of goods are made clear by practical work in the machine room, where the effects due to improper scouring, such as stains, cloudy effects, wrinkles and unclean goods, are demonstrated. The discussion of the necessity of speck dyeing follows naturally from the study of these matters, and includes methods of preparation, materials used, application and tests required.

Carbonizing. — This is an important branch of finishing, and includes a study of the various carbonizing agents, methods of application, strength of solutions and neutralizing, as well as the machines used. Stains and imperfections resulting from carbonizing are also considered. The drying and tentering machines and extractors employed are taken up at this point.

Gigging, Napping and Steaming. — The construction in detail of the various types of gigs, nappers, steamers, wet gigs, rolling, stretching, crabbing and singeing machines is discussed, and their actions upon the cloth and the results obtained are explained.

Various methods of obtaining luster and the production of permanent finish are considered in connection with steaming and sponging.

Brushing, Shearing and Pressing. — This includes, as do the other branches, a careful treatment of the machine employed, the preparation of the cloth for each process, the action of each machine in producing its part of the resultant effect. In manipulation of the shear consideration is given to its setting, grinding and adjustment. With the brushing machine the effect of steaming and moisture upon the luster and feel of the goods is shown. A study of the action of the presses, both plate and rotary, involves consideration of pressure, steaming, etc. Special processes to obtain particular effects are taken up, and the part played by each machine is explained. The details involved in handling cloth on a commercial scale, as, for example, measuring, weighing, ticketing, numbering and rolling, are also explained. The necessary calculation and the methods of finishing all grades of goods are considered from time to time during the year.

711. Cotton Finishing — 1 Year.

The outline of the course in the finishing of cotton fabrics is as follows: —

Cloth Room. — Instruction of the various goods and the object thereof; construction of the various types of inspecting and trimming machines.

Shearing. — The object. A consideration of the various types of shears for treating one or both sides at the same time; also the use of the usual cleaning devices, such as emery, sand and card rolls, beaters and brushes; grinding and the adjustment of the various parts.

The use of brushing and cleaning machines, rolling devices and calender attachments for gray goods.

Singeing. — Developing and object of singeing; the construction of singers of all types, and for various purposes; the use of cooling tanks, steaming devices, rolling and brushing attachments.

Regulation of the flame for various goods, and adjustment of the parts; gas and air pressure, water-cooled rolls; the effect of moisture on the cost of singeing; the use of dry cans in connection with singeing; electric singeing.

Washing. — Open width and string washers, their construction and operation; soaps, temperature, squeeze rolls; washing of various goods and the object thereof; stains.

Napping. — The object of napping and the usual method of treating goods; various types of nappers, single and double acting; felting nappers; construction, grinding and adjustment of various types.

Water Mangles. — Their object and the construction of various types; various rolls, — iron, husk, etc.; scutchers, their object and constructions.

Starch Mangles. — The object and construction of all types of starch mangles for pure starch and filled goods; various types of rolls, — brass, rubber, wood; action of doctor blades, etc.; regulation and object of pressure.

Methods of starching and finishing all standard goods, also a consideration of the various substances used, such as starch, softener and fillers; the preparation of starch and various methods of application.

Dryers and Stretchers. — Both horizontal and vertical, tenter frames, clips; the swing motion and the finishes thus produced; construction; spraying machines, belt stretchers, button breakers; their object and construction.

Calenders. — The object and construction of all types, including the regulation of pressure and nips for the production of various finishes; various types of rolls and their uses, — steel, husk and paper; the use of hot and cold rolls; chasing, friction, embossing and Schriner calenders and the various finishes produced by each; production of watered effects; beetling machines.

Making up room, — yarding, inspecting; different types of folds; pressing, papering, marking.

EVENING GRADUATES OF 1927

Certificates awarded as follows, April 7, 1927:

Cotton Manufacturing — 4 Years.

Marcel Elmer Holt	Lowell, Mass.

Cotton Yarns — 3 Years.

Harold John Ball	Lawrence, Mass.
Albert Eric Broome	Lawrence, Mass.
Kenneth Clarke	Nashua, N. H.
Elliott Tracy Cook	Nashua, N. H.
Joseph Leo Delany	Lowell, Mass.
John Alfred Ebhardt	Lawrence, Mass.

Woolen Manufacturing — 4 Years.

Harlan Dewey Knightly	No. Andover, Mass.

Worsted Manufacturing (Bradford System) — 4 Years.

Henry Bale Halliwell	Lawrence, Mass.
George Duncan Wilson	Lawrence, Mass.

Woolen Yarns — 2 Years.

Byron Lambert Clough	Collinsville, Mass.

Cotton Design — 3 Years.

Parker Leslie Currier	Lowell, Mass.
Edward Joseph Dunn	Lowell, Mass.
Joseph John Higginbottom	Lowell, Mass.
Charles Sumner Parsons	Lowell, Mass.
Roy Evans Snow	Nashua, N. H.

Woolen and Worsted Design — 3 Years.

David Webster Currier	Haverhill, Mass.
Clifford Darwin	Lawrence, Mass.
Richard Joseph O'Brien	Lawrence, Mass.
William Joseph Poole	Lawrence, Mass.

Freehand Drawing — 3 Years.

Martina Lucille Boyle	Lowell, Mass.
Charles Crispin Colmer	Lowell, Mass.
Alice Maude Constantine	Lowell, Mass.

Cotton Weaving — 1 Year.

Romeo Chassé	Nashua, N. H.
Ray William Livermore	Nashua, N. H.
William Lyman Livermore	Nashua, N. H.
Cornelius Paul Murphy	Lowell, Mass.
Andrew Francis Rodgers	Nashua, N. H.
Benjamin Harrington Shaw	Waltham, Mass.

Dobby and Jacquard Weaving — 1 Year.

Henry Banks	Lawrence, Mass.
William Lyman Livermore	Nashua, N. H.
Cornelius Paul Murphy	Lowell, Mass.
Benjamin Harrington Shaw	Waltham, Mass.
Roy Evans Snow	Nashua, N. H.
George Sotnick	Lowell, Mass.

Woolen and Worsted Weaving — 2 Years.

David Webster Currier	Haverhill, Mass.
Everett Baker Dunkerley	East Chelmsford, Mass.
William Ford, Jr.	Lawrence, Mass.
Daniel John Gannon	Lowell, Mass.
Carl Leslie Lofgren	Lawrence, Mass.
Edward Fred Miller	Lawrence, Mass.
John George Schoepf	Lawrence, Mass.

Cotton Finishing — 1 Year.

Robert Ringwalt Ballantyne	Lowell, Mass.
Paul Joseph Choquette	Lowell, Mass.
Herbert Roby Covey	Nashua, N. H.
Raymond Gates Flanders	Nashua, N. H.
Raymond Lemuel Gallagher	Nashua, N. H.
Paul Morris Hill	Nashua, N. H.
Reginald Guy Norton	Andover, Mass.
Carl Werner Ostrom	Lawrence, Mass.
Benjamin Franklin Pulsifer	Nashua, N. H.
Lawrence Alexander Savage	Lowell, Mass.
Elmer James Stickney	Nashua, N. H.
Jules Von Dittweiler	Lawrence, Mass.
Harold Lee Wheeler	Nashua, N. H.

Woolen and Worsted Finishing — 1 Year.

James Armitt	Lawrence, Mass.
William Christie	Lawrence, Mass.
David Webster Currier	Haverhill, Mass.
William Clough Currier	No. Andover, Mass.
Frederick William Gatenby	No. Chelmsford, Mass.
Lester George Herlihy	No. Chelmsford, Mass.
James Harrington Kennedy, Jr.	Lowell, Mass.
Benjamin Miller	Andover, Mass.
George Robinson Rhodes	Lawrence, Mass.
Wilfred Robert Svenson	Andover, Mass.
Louis Micholes Zannini	Lowell, Mass.

Elementary Chemistry — 2 Years.

John Rostron Berwick	Lawrence, Mass.
Howard Franklin Crosby	Lowell, Mass.
Lawrence Manual Ralph Davidson	Nashua, N. H.
Hubert Arthur Fletcher	Methuen, Mass.
Fred Albert Hickey	Lawrence, Mass.
Raymond James Leaver	Lawrence, Mass.
Donald Rhodes Lewis	Lowell, Mass.
Francis Lewis McParland	Lawrence, Mass.
Frank James O'Neil	Lawrence, Mass.
Earl Whitney Pulsifer	Nashua, N. H.
Albert Reinhold	Lawrence, Mass.
William Edward Schmottlach	Lawrence, Mass.

Textile Chemistry and Dyeing — 3 Years.

William Kelly	Lowell, Mass.
Joseph Christopher McInerney	Lowell, Mass.
John Ashworth Peel	No. Andover, Mass.
Lawrence Elbridge Remick	Braintree, Mass.

Quantitative Analysis — 3 Years.

George Henry Bouchard	Lowell, Mass.
James Edward Doole	Lowell, Mass.
Emile Louis Musat	Lowell, Mass.

Mechanical Engineering — 3 Years.

Albert Irvin Alexander, Jr.	Lawrence, Mass.
Joseph Colin Chisholm	Lowell, Mass.
Carl Benjamin Laidlaw	Lowell, Mass.

Mechanical Drawing — 3 Years.

Paul Arnum Connor	Lowell, Mass.
Gilford Edmund Flewwelling	Lowell, Mass.
Raymond André Gaudette	Lowell, Mass.
John Anais McEntee, Jr.	Lowell, Mass.
Samuel Royce McMaster	Lowell, Mass.
Frederick Herbert Picking	Westford, Mass.
John Delbert Stewart	Lowell, Mass.
Edward John Witzgall	Lawrence, Mass.
Arthur William Worth	Lowell, Mass.

Machine Shop Practice — 2 Years.

Earle Fredrick McQuaide	Lowell, Mass.
Odina Martel	Lowell, Mass.

Electrical Engineering — 3 Years.

Paul Patrick Cashman	Lowell, Mass.
Alfred Joseph Goudreault	Lowell, Mass.
Joseph LaBelle	Lowell, Mass.
Howard Lester MacDonald	Lowell, Mass.
Oral Erwin Stoddard	Nashua, N. H.
Prentice Church Taylor	Lowell, Mass.

Mathematics — 2 Years.

James Paul McKinley	Lowell, Mass.
Charles Richard Martin	Nashua, N. H.
Forrest Raymond Small	Lowell, Mass.

Steam — 1 Year.

Alfred Rotondo	Methuen, Mass.

Strength of Materials — 1 Year.

John Joseph Owril	Lawrence, Mass.
Alfred Rotondo	Methuen, Mass.
Everett Claude Sudsbury	Nashua, N. H.

Direct Current Electricity — 2 Years.

George Watkins Britton	Nashua, N. H.
Paul Westcott Buxton	Hudson, N. H.
George Alexandre Éno	Lowell, Mass.
Calman Hoffman	Lowell, Mass.
Silas Levine	Lowell, Mass.
Clarence Floyd Morton	Lowell, Mass.
Frank Vera Perry	Nashua, N. H.
Eric Arthur Peterson	Lowell, Mass.
Harold Daniel Quinn	Lowell, Mass.
Manuel Mello Veiga	Lowell, Mass.

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WHAT CONSTITUTES AN ADEQUATE EDUCATION FOR A TEXTILE CHEMIST AND COLORIST?[1]

By Louis A. Olney, B.S., M.S., Sc.D., *Professor of Chemistry and Dyeing.*

We always have had, and probably always will have, in our midst the man who boasts that he is "self made" (whatever that may indicate) and who contends that much time spent in securing an education is not merely a waste of time but may even prove to be an encumbrance. He is perfectly honest in his belief and any attempt to convince him that he might be even a little bit wrong would be futile.

It cannot be disputed that many men have been highly successful in connection with the Textile Industry who have had little if any education. Men who possessed natural ability, particularly along the mechanical line, together with a mind of the type that had a tendency to systematize and organize their thoughts and actions even though they had but little academic or scientific education, became quite efficient mill men after a few years of experience in what they were pleased to characterize as the "School of Hard Knocks".

However, be this as it may, the extravagant losses, economic wastes, and colossal blunders that have come about in Industry through unconscious ignorance and lack of education would, if they could be measured, prove to be appalling.

Furthermore, could we suddenly place the man who was highly successful under the conditions of fifty or sixty years ago, with its long hours, its wasteful handling of materials, and in many cases but little competition, into the present era of highly organized methods of cost finding, efficient management and keen competition, he would in most cases be likely to fall down completely, at least until he had secured sufficient education to fit him for his position.

In other words, fifty years ago there was so little known about scientific management or even the fundamentals of scientific manufacturing that one could quite readily pick up all that was absolutely necessary as he came along. Today, however, the situation is quite different. There are so many highly important things known, and so many that must be learned if one would secure a position of any importance, say nothing of holding it, that the only way to get it and save time is via the road of a systematic education.

What we have said of the Textile Industry in general is even of greater applicability when we consider the specialized field of Textile Chemistry and Dye Application, and we doubt if even the most successful rule-of-thumb devoteé, no matter how much he stressed the value of practical experience as compared with theoretical knowledge, would not admit today that systematic education of the proper type presented the most effective if not the quickest way to gain entrance and make subsequent progress in this branch of the industry.

During the early days of my educational experience I was so frequently asked the question "What is the difference between a Textile Chemist and a Textile Colorist, and between a Textile Colorist and a Dyer?" that I found it quite necessary to define each more or less clearly, at least in my own mind.

From my point of view a *Textile Chemist* is one who is fundamentally a thorough chemist but in addition has specialized upon the properties and composition of the various textile fibers, and upon the chemicals (including dyes) which are used in their bleaching, dyeing, printing and finishing. He must also be well posted as to the chemical reactions which take place between such chemicals and dyes, and the textile materials which are commonly used in the textile industry. In general he knows more or less about the dyeing of textile materials but he would not be expected to have sufficient experience to go out and run the dyehouse.

The *Dyer* is one who has had a broad experience in the application of dyes and is well skilled in manipulative technique and in color matching. He may or may not have a knowledge of chemistry, but the more he learns about the nature of the materials he is handling, both chemicals and fibers, the more intelligent and progressive dyer he will become.

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[1] A paper presented at the Sixth Annual Meeting of the American Association of Textile Chemists and Colorists, New York City, December 2, 1927.

The *Textile Colorist* is one with a broader knowledge and more general experience than either the textile chemist or the dyer. Like the Textile Chemist he is fundamentally a well-trained chemist, and has made a thorough study of the dyes from the point of view of both their composition and properties, and has had sufficient experience with their use so as to be able to direct large scale processes of their application, and he can if necessary take immediate charge of the operation. He might not have the manipulative skill of the Textile Chemist if routine analytical work were involved, but he would ordinarily know more about the composition, properties and application of dyes, and be better able to visualize the chemical as well as physical mechanism of the combined processes of bleaching, dyeing, printing and finishing.

The term *Color Chemist* is applicable to one who has specialized upon the structure of dyes and the chemistry involved in their manufacture. He usually has little if any knowledge as to their practical application and no direct connection with the textile industry, and need not be considered in our discussion.

With these preliminary remarks in mind we may be better able to answer the question "What Constitutes an Adequate Education for the Textile Chemist and Colorist?"

The first requirement of all is a thorough course in chemistry, and if this can be combined with an intensive study of the chemistry of the fibers and the dyes, together with dyestuff application, much more may be accomplished in a given period of time. This is the advantage which one derives by taking a course at a Textile School of recognized standing. Furthermore, the "textile background" or "setting" which such an institution presents is entirely missing in the regular chemistry course at an ordinary college or university. This is of inestimable value since the constant observation of textile machinery in operation and the association with men upon the instructing staff who are experts in different branches of textile manufacture, to say nothing of the contacts and conversations with a host of young men, all aspiring to become the future leaders in the industry, are bound to give an emphasis and real meaning to the students' daily work that could never be hoped for in the college or university.

If we consider the Textile Industry from all angles probably no industry involves the application of a greater number of chemical principles and a greater variety of chemical compounds. In the first place, there are the raw materials of the industry, namely, the fibers, all of which are extremely complicated colloidal organic compounds, and in chemical reactions with these we have all of the compounds used in bleaching, scouring, mordanting, dyeing and finishing. As a result there are involved some of the most complicated reactions of chemistry, in fact, so complicated that many of them are not as yet fully understood. The composition, properties and reactions of the numerous Coal Tar Dyes are also involved and among these we find some of the most complicated of organic compounds. In addition to these considerations, which are primarily of a textile nature, the textile chemist must be thoroughly acquainted with water for industrial purposes, fuels, oils and all of the problems of combustion and lubrication which are constantly arising in almost any industrial plant.

As a result the textile chemist must have as thorough and complete a training in General Chemistry as would be required of an industrial chemist or chemical engineer in any other branch. Furthermore, such a fundamental training must not only involve Inorganic Chemistry but Organic and Physical Chemistry, as well as the application of these subjects to Analytical Chemistry. It is needless to say that a thorough training in Mathematics and Physics is absolutely essential as a foundation for such a course.

The course in Textile Chemistry and Dyeing at the Lowell Textile School has been planned with all this in mind. The qualifications for admission are the generally recognized standard college requirements, and the course extends through four years and leads to the Bachelor's Degree.

The curriculum may be divided into three groups of studies approximately equal as far as time occupied is concerned, and running more or less simultaneously throughout the four years.

First: A combination of chemical subjects which, taken as a whole, provide a

comprehensive course in chemistry, in the broader sense. This extends through the entire four years and includes Inorganic, Organic and Physical Chemistry.

Second: The specialized study of Textile and Color Chemistry, including dye application, dye testing and color matching. This group also includes the study of Textile Finishing and the Principles of Textile Design.

Third: The more fundamental sciences and cultural subjects, including Mathematics, Physics, German, English, Industrial History and Economics.

As already stated, it is highly desirable that the student should spend at least two summers during such a course in the works, preferably in the dyehouse, and he should be encouraged to visit as many textile plants as time and opportunity will permit.

Every effort should be made to teach the student how to think and apply the facts which he is constantly acquiring.

With such an educational foundation, followed by several years of practical experience after graduation, we believe that the best and most successful type of Textile Chemist and Colorist will surely develop.

If one wishes to become merely a rule-of-thumb dyer, there is no question but that he should go immediately into the dyehouse, for in this way he will make more rapid progress in attaining his desire. It will be found, however, in most cases, that within seven or eight years the student who entered upon his four-year course at the same time the dyer entered the dyehouse will be much farther along upon the ladder which leads to success, and with a future ahead that presents far greater opportunities for advancement.

Of course much depends upon the natural ability of the man, and this is more of a factor than is generally supposed, but given a student of average ability or better, one who is keenly interested in his work, and willing to continue his studies in order to keep up with new developments, and I can predict with ninety per cent accuracy the degree of success he will have attained within five or ten years after graduation. A study of our classified list of about one hundred eighty living graduates of the Chemistry and Dyeing Department of the Lowell Textile School will unquestionably justify this statement.

The opinion was previously expressed that the ordinary college and university did not offer to the student a sufficiently effective textile background. In order that this statement may not be misinterpreted we will add that the ideal condition would be to require a college training of every student who enters upon such a course as has been described. This is today being recognized as highly desirable for students of medicine and law; why not for students of Textile Chemistry and dye application? With such a preliminary training the four-year course might be cut to three years and possibly to two if the preliminary college course were properly arranged.

The advisability of overcoming the inadequacy of a four-year course for the most thorough training of the Textile Chemist and Colorist by the addition of a post-graduate year leading to the Master's Degree has been proposed and is being considered at the present time.

Such a five-year course for the more ambitious student of ability would undoubtedly more adequately fulfill the requirements and counterbalance the lack of a previous college training.

BULLETIN

OF THE

Lowell Textile School

LOWELL, MASS.

Issued Quarterly

1928

Moody Street and Colonial Avenue

Publication of this Document Approved by the Commission on Administration and Finance

Southwick Hall

NOTICE

By Legislative Act of 1928 the name
LOWELL TEXTILE SCHOOL
will on and after June 19, 1928 be changed to

LOWELL TEXTILE INSTITUTE

SERIES 31, No. 3 February, 1928

Bulletin

of the

Lowell Textile School

LOWELL, MASS.

Issued Quarterly

1928

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Moody Street and Colonial Avenue

Publication of this document approved by the Commission on Administration and Finance
6,600 2-'28 Order 1441

CALENDAR

1927–1928

September 15–16, Thursday–Friday . .	Entrance Examinations.
September 19–24, Monday–Saturday . .	Re-examinations.
September 21, Wednesday 9.00 A.M. . .	Registration for Freshmen.
September 26, Monday	Registration for upper-classmen. Classes begin for Freshmen.
September 27, Tuesday	Classes begin for upper-classmen.
October 12, Wednesday	Columbus Day — Holiday.
November 22, Tuesday 4.30 P.M. . . .	Thanksgiving recess begins.
November 28, Monday 9.00 A.M. . . .	Thanksgiving recess ends.
December 16, Friday 4.30 P.M.	Christmas recess begins.
January 3, Tuesday 9.00 A.M.	Christmas recess ends.
January 23, Monday	First term examinations begin.
February 3, Friday	End of first term.
February 6, Monday	Second term begins.
February 22, Wednesday	Washington's Birthday — Holiday.
April 18, Wednesday 4.30 P.M.	Spring recess begins.
April 23, Monday 9.00 A.M.	Spring recess ends.
May 21, Monday	Second term examinations begin.
May 30, Wednesday	Memorial Day — Holiday.
June 5, Tuesday	Commencement.
June 7–8, Thursday–Friday	Entrance Examinations.

1928–1929

September 13–14, Thursday–Friday . .	Entrance Examinations.
September 17–22, Monday–Saturday . .	Re-examinations.
September 19, Wednesday 9.00 A.M. . .	Registration for Freshmen.
September 24, Monday	Registration for upper class students. Classes begin for Freshmen.
September 25, Tuesday	Classes begin for upper class students.
October 12, Friday	Columbus Day — Holiday.
November 20, Tuesday 4.30 P.M. . . .	Thanksgiving recess begins.
November 26, Monday 9.00 A.M. . . .	Thanksgiving recess ends.
December 21, Friday 4.30 P.M.	Christmas recess begins.
January 2, Wednesday 9.00 A.M. . . .	Christmas recess ends.
January 21, Monday	First term examinations begin.
February 1, Friday	End of first term.
February 4, Monday	Second term begins.
February 22, Friday	Washington's Birthday — Holiday.
April 17, Wednesday 4.30 P.M.	Spring recess begins.
April 22, Monday 9.00 A.M.	Spring recess ends.
May 20, Monday	Second term examinations begin.
May 30, Thursday	Memorial Day — Holiday.
June 4, Tuesday	Commencement.
June 6–7, Thursday–Friday	Entrance Examinations.

OFFICERS OF INSTRUCTION AND ADMINISTRATION

Charles Holmes Eames, S.B. . . . . Billerica.
President.

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Professor of Textiles; in charge of Department of Wool Yarns.
Arthur Andrew Stewart . . . . 56 Robbins Street.
Professor of Textiles; in charge of Department of Finishing.
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Professor of Textile Design; in charge of Department of Design and Weaving.
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Professor of History and Economics; in charge of Department of Languages, History and Economics; Secretary of the Faculty.
Herbert James Ball, S.B., B.C.S. . . . . . . 119 Wentworth Avenue.
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Gilbert Roscoe Merrill, B.T.E. . . . . . . 364 Varnum Avenue.
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Glenys Gertrude Green . . . . 11 White Street.
Clerk.

HISTORICAL SKETCH
of the
LOWELL TEXTILE SCHOOL

The Lowell Textile School was established by the Trustees of the Lowell Textile School of Lowell, Massachusetts, incorporated in accordance with chapter 475, Acts of 1895. The movement for the establishment of the school dates from June 1, 1891, but it was not opened for instruction until February 1, 1897.

In accordance with the acts of incorporation the Board of Trustees consisted of twenty permanent and self-perpetuating members, three-fourths of whom must be "actively engaged in, or connected with, textile or kindred manufactures." In addition, His Honor the Lieutentant-Governor, the Commissioner of Education of the State, the mayor, the president of the municipal council, the superintendent of schools of Lowell, and a representative of the textile council were members *ex officio*. Legislative acts of 1905 and 1906 authorized the graduates of the school to elect four trustees serving for periods of four years each.

By virtue of the anti-aid amendment to the State Constitution, and by chapter 274, General Acts of 1918, the property of the school was transferred on July 1, 1918, to the Commonwealth of Massachusetts, and the control and management of the school was vested in a Board of Trustees appointed by the Governor, "with all the powers, rights and privileges and subject to all the duties" of the original Board.

In locating the school at Lowell, which has been called the "Mother Textile City of America," considerable advantage is secured by close association with every branch of the industry, which utilizes almost every commercial fiber in the products of the great Merrimack Valley textile district.

Although the school was formally opened by Governor Roger Wolcott on January 30, 1897, in rented quarters in the heart of the city, it was not until January, 1903, that the first buildings of the present plant were ready for occupancy. On February 12, 1903, Governor John L. Bates dedicated the present buildings.

PURPOSE AND SCOPE OF THE SCHOOL

The object of the establishment of the school as set forth in the original act was "for the purpose of instruction in the theory and practical art of textile and kindred branches of industry."

The plan was occasioned by the apparent crisis in the leading industry of New England, due to the rapid development of the manufacture of the coarser cotton fabrics in the southern States. It was believed that this crisis could be met only by a wider and more thorough application of the sciences and arts in the production of finer and more varied fabrics.

Following the general methods and systems found successful at the higher polytechnic institutes, it offers thorough instruction in principles of the sciences and arts applicable to textile and kindred branches of industry. The courses treat not only of the theory but also the application of these principles in the processes, on the machines and throughout all departments of industry involved in the successful manufacture, application and distribution of textile material in any form.

Though from the first the management has kept in view the clearly defined objective which called for the establishment of the school, to meet the needs of the textile and kindred industries, it has developed its curriculum, its methods of instruction, and equipment as those needs arose. This objective will be kept constantly in view, and as new demands are presented an effort will be made to extend courses, equipment and floor space. The mechanical equipment of the school includes the best makes of textile machinery, and these machines, while built as they would be for regular work, are, as far as possible, adapted to the experimental work which is of particular value in such an institution as this. There is a more varied equipment in this school than in any other, either in America

or Europe, and it is now possible to convert the raw stock into the finished fabric within the school.

Because of the breadth, grade and character of instruction given, and because of the standing and personnel of the instructing staff, the school has been placed by both Federal and State educational boards in the class of the higher technological schools of this country.

The United States Civil Service Commission recognizes graduates from the degree courses of this school as proper applicants for the examination to the various positions requiring a knowledge of applied science and engineering, as well as a knowledge of textile manufacturing, in the different departments of the government.

The day classes have been organized for those who can devote their entire time for three or more years to the instruction requisite in preparing to enter the textile industries. It has been found necessary to require of all such students educational qualifications equivalent to those given by a regular four-year course of a high school or academy of good standing.

The evening classes are held for about twenty weeks of the year, and are for those who are unable to attend the day courses. These are similar to the day courses, but are aimed especially to meet the needs of students working during the day in the mills and shops. For entrance to these classes an applicant should have the equivalent of a grammar school education. A detailed description of these courses and requirements is given in another Bulletin, which will be sent upon request.

BUILDINGS AND GROUNDS

The site is a commanding one, consisting of about 15 acres at a high elevation on the west bank of the Merrimack River. It extends to and overlooks the rapids of Pawtucket Falls, which was the first water power in America to be used on an extensive scale to operate power looms. It was contributed by Frederick Fanning Ayer, Esq., of New York City, and the Proprietors of the Locks and Canals on the Merrimack River.

Southwick Hall, the main building, fronting on Moody Street, was contributed by the Commonwealth of Massachusetts and Frederick Fanning Ayer, Esq., and is a memorial to Royal Southwick, a leading textile manufacturer, a public man of earlier days, and a maternal ancestor of Mr. Ayer. It includes a central mass 90 by 90 feet, having three stories and two wings 80 by 85 feet each with two stories and well-lighted basements. The building is pierced in the center by an arched way from which access is had to the wings and to the central courtyard. The northern wing is occupied by the General Offices, Engineering and Finishing departments, and Library, while the southern wing is entirely occupied by the Chemistry and Dyeing departments.

Kitson Hall, dedicated to the memory of Richard Kitson, was contributed by Charlotte P. Kitson and Emma K. Scott, his daughters; the Kitson Machine Company of Lowell, founded by Mr. Kitson, was also a generous contributor. This hall makes a right angle with Southwick Hall, is 70 by 183 feet, and has two stories and a basement. The first floor is occupied by the Cotton Yarn and Knitting departments, while the basement contains the Mechanical and Electrical Engineering laboratories and the Machine Shop.

The Falmouth Street Building forms the third side of the quadrangle, and consists of three portions, one 60 by 75 feet, three stories, one 75 by 130 feet, three stories, and the head house 70 by 80 feet, three stories and basement. The building is occupied by the picker section of the Cotton Yarn Department, the Design and Power Weaving Department and by the Woolen and Worsted Yarn Department, and contains on the lower floors an equipment for the manufacture of wool yarn from the fleece to the finished yarn. The upper floors are occupied by a great variety of plain, dobby and Jacquard looms, and in a section of the building are the students' lockers and recreation rooms.

Colonial Avenue Building was erected in the summer of 1910 from plans prepared by the Engineering Department, which also had in charge the work of

construction. The building completes the fourth side of the quadrangle, and in outward appearance corresponds to the architectural features of the other school buildings. It is a single-story building, and has the dimensions of 195 by 60 feet. Its interior is faced with cement brick made at the school during the progress of the work. These serve to give light reflecting walls which are advantageous for the work of the Wool Manufacturing, Cotton Finishing and Chemistry and Dyeing departments that occupy this building. The funds for this building were provided by the State of Massachusetts.

The buildings are of modern mill construction adapted to educational uses and contain approximately 180,563 square feet.

CAMPUS

Through the generosity of Mr. Frederick Fanning Ayer the school has been provided with a campus and athletic field of about 3 acres. This has been carefully graded and laid out for baseball, football and track athletics.

To enclose this field the Alumni Class Fence has been partly built. It is made of forged iron sections supported between brick columns. Each section is contributed by a class, so that in the course of a few years this fence will entirely enclose the field.

On the upper floor of the Falmouth Street Building there has been provided a recreation room for the use of the students at such times as their attendance is not required in classes.

In the basement of this building there are rooms for the use of the athletic teams. Connected to these are showers and dressing rooms.

The upper hall of Southwick Hall has been equipped with gymnastic apparatus. Chest weights, wooden dumb-bells, Indian clubs, a set of traveling rings, a vaulting horse, parallel bars, a punching bag and several sets of foils and single sticks have been provided.

In order to be sure that no student having any dangerous physical weakness takes part in any athletic contest, all candidates for the various athletic teams are obliged to pass a satisfactory physical examination.

ENTRANCE REQUIREMENTS

Particular stress should be laid upon a thorough grounding in mathematics, including algebra, arithmetic and plane geometry, as these form the basis upon which the work of this school rests. While solid geometry is not required at the present time, the student will find a knowledge of this subject very valuable in his subsequent work, and is strongly recommended to include this subject as one of his electives. A preliminary course in science, including physics, and chemistry, serves to prepare the student's mind for the higher branches of these subjects and their application, but neither will be considered as the equivalent of the courses in these branches given in the school.

Degree Courses

Candidates for admission to either of the degree courses must be graduates of a school approved by the New England College Entrance Certificate Board or by the Board of Regents of New York, and must present a certificate from the principal of the school last attended, reporting upon the subjects pursued and the points obtained according to the schedule of studies given hereafter. A total of fourteen points is required.

A point represents satisfactory work in a year's study in a specified subject in an approved secondary school.

Required Subjects	Points
Algebra A1	1
Algebra A2	1
English	4
Elementary French A (two years) or Elementary German A (two years)	2
Plane Geometry	1
History (American, Mediæval and Modern, or English)	1
Physics	1
	11

Elective Subjects	Points
Chemistry	1
Elementary French (two years) or Elementary German (two years)	2
Advanced French or German (one year in addition to requirements of Elementary French A or Elementary German A)	1
History:	
American	1
Mediæval and Modern	1
English	1
Latin	1
Mechanical Drawing	1
Mechanic Arts	1
Solid Geometry	1
Spanish	1
Trigonometry	1

An applicant may also be admitted on the basis of entrance examinations in which case he must pass a sufficient number of the required subjects to make ten points, and present certificates showing satisfactory courses in such of the elective subjects to make three additional points.

The objective of the elective requirements is to encourage greater breadth of preparation than that covered by the required branches. Certificates covering other subjects than those listed as elective will be entertained.

Diploma Courses

Candidates for admission to the diploma courses are accepted upon presentation of properly vouched certificates showing the completion of a regular four-year course in a high school or academy of reputable standing. The certificate must specify that the applicant has satisfactorily passed the required subjects.

A total of twelve points is required.

Required Subjects	Points
Algebra A1	1
Algebra A2	1
English	4
Plane Geometry	1
History (American, Mediæval and Modern, or English)	1
Physics	1
	9

Elective Subjects

Three may be selected from the list under Degree Courses.

ENTRANCE EXAMINATIONS

All students who are unable to present a certificate for either the degree or the diploma courses must pass entrance examinations. Notification of intention to take these examinations must be made in writing at least a week before the date of the examinations. These will be held as follows: —

Thursday, June 7, 1928; Thursday, September 13, 1928; Thursday, June 6, 1929: —
- Algebra, 9 A.M. to 11 A.M.
- History, 11 A.M. to 1 P.M.
- English, 2 P.M. to 4 P.M.

Friday, June 8, 1928; Friday, September 14, 1928; Friday, June 7, 1929: —
- Plane Geometry, 9 A.M. to 11 A.M.
- German or French, 11 A.M. to 1 P.M.
- Physics, 2 P.M. to 4 P.M.

Candidates failing to pass the June examinations are allowed to try again in September; those who cannot attend the June examinations may present themselves in September.

REQUIRED SUBJECTS FOR ENTRANCE

Algebra A1. — Fundamental operations, factoring, determination of the highest common factor and least common multiple, fractions, simple and complex, simple equations of one or more unknown quantities, problems involving linear equations of either numerical or literal quantities, radicals, involution and evolution, square and cube root, ratio and proportion, exponents including fractional and negative.

Algebra A2. — Quadratic equations both numerical and literal. Simple problems involving one or more unknown quantities that may be solved by the methods of linear or quadratic equations, binomial theorem for positive integral exponents, problems involving methods of arithmetical and geometrical progressions.

Plane Geometry. — The usual theorems and constructions of good textbooks, including the general properties of plane rectilinear figures, the circle and the measurement of angles, similar polygons, areas, regular polygons, and the measurement of the circle. The solution of original problems and problems in mensuration of lines and plane surfaces.

English. — As secondary schools are following to a greater extent than heretofore the requirements of the College Entrance Examination Board, it is recommended that the applicant to this school conform to the suggestions of this Board relative to English composition and literature.

The examination consists of two parts, both of which are given at the same time.

(*a*) With the object of testing the student's ability to express his thoughts in writing clearly and correctly he will be required to write upon subjects familiar to him. Emphasis will be laid upon the composition, punctuation, grammar, idiom and formation of paragraphs. He will be judged by how well he writes rather than by how much he writes.

(*b*) The second part of the examination is prepared with the view of ascertaining the extent of the student's knowledge of good literature, and to test this examination questions will be based on the books adopted by the National Conference on Uniform Entrance Requirements. Any course of equivalent amount if made up of standard works will be accepted.

History.—Applicants may offer a preparation of American history, English history or mediaeval and modern history.

In American history applicants should be familiar with the early settlements in America, the colonies, their government, the customs of the people, and events which led to the establishment of the United States. They should be informed concerning the causes and effects of the principal wars in which the country has been involved. They should be prepared to consider also questions requiring an elementary knowledge of civil government, as well as historical facts connected with the growth of this country up to the present time.

For the subject of English history or mediæval and modern history the course given in any reputable secondary school should give proper preparation. A course extending over a full year with not less than three periods a week will be accepted.

Physics.—The applicant should be familiar with the fundamental principles of physics, particularly those considered under the headings of mechanics, heat, light, electricity and magnetism. Textbook instructions should be supplemented by lecture table experiments. Wherever possible, the student should pursue a laboratory course, but for the present no applicant will be conditioned in this subject if he has not been able to carry on a laboratory course. Where a laboratory course is offered by a secondary school, it should cover at least twenty-five of those experiments listed in the syllabus of the College Entrance Examination Board.

Modern Languages.—Required for degree courses only. It is expected that the work in these subjects has covered a period of at least two years of preparatory school training or the equivalent. Importance should be given to the ability to translate into good idiomatic English, but attention should also be paid to grammar and construction, that greater care may be used in translation.

Elementary German A. — The entrance examination is composed of two parts, both taken, however, at the same time.

(*a*) Translation of simple German prose into good idiomatic English.

(*b*) Questions to test proficiency in grammar, and simple English sentences to be rendered into German.

The requirements include the declension of articles, adjectives, pronouns and nouns; the conjugation and inflection of weak and strong verbs; the simpler uses of the subjunctive; the use of the modal auxiliaries; the prepositions and their uses; the principal parts of important verbs; and the elementary rules of syntax and word order.

Texts used in the language courses of any reputable high or preparatory school will furnish reading for translation. A list of texts is offered by the College Entrance Examination Board.

Elementary French A. — The entrance examination is composed of two parts, both taken, however, at the same time.

(*a*) Translation of simple French prose into good idiomatic English.

(*b*) Questions to test proficiency in grammar, and simple English sentences to be rendered into French.

The requirements include the principal parts, conjugation and inflection of the regular and the more common irregular verbs; the singular and plural forms of nouns and adjectives; the uses of articles and partitive construction; the forms and positions of personal pronouns; and the simpler uses of the conditional and subjunctive.

Suitable texts are suggested by the language courses of any reputable high or preparatory school and by the requirements of the College Entrance Examination Board.

Students who have pursued two years of elementary French as well as two years of elementary German may present one subject to cover two points in the required subjects, and the other to cover two points in the elective subjects.

ELECTIVE SUBJECTS

History. — If the applicant can present all three or any two branches of history specified he may include one as a required subject and the others in the list of elective subjects.

Chemistry. — Applicants must show evidence of their familiarity with the rudiments of chemistry. Any course given in a secondary school organized to present instruction by means of textbook or lecture, together with correlated laboratory work, will be considered as covering the requirements. The applicant's notebook with his original notes, including description of experiment, apparatus used, reactions, observations and deductions, must be accompanied by his instructor's certificate.

Importance will be placed upon manipulation and deductions as well as the general appearance and neatness of the notebook.

Solid Geometry. — The usual theorems and constructions of good textbooks, including the relations of planes and lines in space, the properties and measurement of prisms, pyramids, cylinders and cones; the sphere and spherical triangles. The solution of original problems and the applications of the mensuration of surfaces and solids.

Trigonometry. — The usual courses of instruction covered by the standard textbooks on plane and spherical trigonometry will prepare an applicant sufficiently to meet this requirement.

Mechanical Drawing. — The applicant must have pursued such a course in mechanical drawing that he will be familiar with the usual geometrical construction problems, projection of points, lines, planes and simple solids.

Importance is laid not only upon the accuracy with which the work is performed, but upon the general arrangement, appearance and care with which the plates are executed.

It should not be understood that work in this subject may be offered as the equivalent of the first term's work at the school.

Mechanic Arts. — The usual courses offered by properly equipped preparatory schools will be accepted as suitable fulfillment of this requirement. Work should

include instruction in the handling of both wood and metal working tools in the more simple practices of these arts.

Elementary French B. — Applicants who enter for one of the three-year courses may present one year's work in French in a secondary school. Those who present themselves for examination in this subject should be familiar with the rudiments of grammar, and be able to translate simple French prose into good idiomatic English, also to translate into French English sentences, based on the French given for translation.

Elementary German B. — Applicants who enter for one of the three-year courses may present one year's work in German in a secondary school. What is stated in regard to French applies to those who may present German instead of French.

Advanced French or German. — In cases where applicants have pursued courses in French or German for more than two years, and have completed work which is more advanced than is included under elementary French or German, they may offer the additional year as an elective.

Spanish. — Students offering Spanish should be familiar with elementary grammar, the common irregular verbs, and be able to translate simple Spanish to English or English to Spanish. A preparation equivalent to three periods per week for two years will be acceptable.

Latin. — Students who have pursued one or more years of Latin may present this subject as an elective. Each year's work satisfactorily completed will be considered equal to one point.

ADVANCED STANDING

Candidates who may have received previous training in any of the subjects scheduled in the regular course will, upon presentation of acceptable certificates, be given credit for such work.

GRADUATE COURSES

Graduates of technical courses of other schools are invited to communicate with the president with reference to special courses in the textile studies. Previous training in the sciences and the engineering branches will usually reduce materially the time necessary to complete any of the courses at this school. The advantages offered to such persons for special research work are unexcelled, and a most profitable course may be arranged.

COURSES OF INSTRUCTION

Degree Courses.—The four-year degree courses are as follows:

Textile Engineering
Chemistry and Textile Coloring

At the completion of these courses the degrees of Bachelor of Textile Engineering (B. T. E.) and Bachelor of Textile Chemistry (B. T. C.) are conferred.

Three options are offered in the Engineering Course, viz., general textile, cotton manufacturing or wool manufacturing. Each of these courses is planned to train one in the fundamental principles of science found to be applicable in the particular fields of textile chemistry and textile engineering. It is maintained that for one to be successful in either of these important branches of industry a training is required as thorough and broad as that of any of the recognized branches of engineering or of applied science.

With this in mind these courses have been built of a secure framework of science and mathematics, and to it has been added the useful application of these branches in the broad textile field. With the direct purpose of laying a secure foundation in the training, a more extended preparatory course is first demanded, and subsequently in the school work more subjects of a general character are included, that narrowness of judgment and observation may not result by overstimulation of the technical development.

Diploma Courses.—The following courses extend over a period of three years and upon the completion of any one of these the diploma of the school is awarded:

Cotton Manufacture
Wool Manufacture
Textile Design

COURSES FOR WOMEN

Although all classes are open to women, the courses which have appealed especially to their tastes have been textile designing and decorative art. Some have pursued courses in chemistry, and have added to their work in design some instruction in power weaving and finishing. These special courses have in general been followed for three years, and in some cases have led the students to positions either in the mill office or in some commercial lines that have been desirable and have offered congenial work.

Within the last few years the possibilities for women in certain branches of textile chemistry have become recognized, and it is believed that in the future the positions open to them will become more and more numerous.

GENERAL INFORMATION

Application for Admission.—A blank form of application for admission may be found at the end of this bulletin. This should be properly filled out by all applicants, whether entering upon certificate from a secondary school or presenting themselves for examination.

Freshman Registration.—Each freshman is expected to be in daily attendance beginning Wednesday, September 19, at 9.00 A. M. and to follow the prepared program which will be placed in his hands. A program which is planned to acquaint the new student with the institution, its location and surroundings, its courses of instruction, its recreational activities and other phases of its life is arranged for the opening week. Unless arrangements for room and board are made previously, the first two days of the week may be used for this purpose. Physical examinations as well as certain other tests are given during this orientation period. Freshman week enables the student to secure the advantages which come from acquaintance with his surroundings, his instructors, the members of his class, student organizations, activities and customs. The over-crowding of the first week of classes with distractions is thus avoided.

Registration.—All upper classmen are required to register on or before the Monday of the week beginning the school year, and all students during the midyear examination period. For unexcused delay in registration a fee of $5 will be imposed.

Sessions. — The regular school sessions are in general from 9.00 A.M., to 12.50 P.M., and from 1.55 to 4.30 P.M., except Saturdays, when there is no session of the school. On Saturday afternoons the buildings are closed.

An hour plan designates the hours at which the various classes meet. This is rigidly adhered to, and the student is marked for his attendance and work as therein scheduled.

Attendance. — Attendance is required of all students on fourteen-fifteenths of all scheduled class exercises, provided they meet the requirements of their instructors for the omitted exercises. For every unexcused absence from any class exercise in excess of those allowed, a deduction from the mark obtained in the course in which the absences occurred will be made.

Advisers. — Advisers are appointed for all students, to be of such aid and assistance as they can both inside and outside of school hours. The head of the department in which a student is registered is adviser to upper-classmen, and instructors in charge of freshman classes act as advisers to freshmen.

Conduct. — Students are required to return to the proper place all instruments or apparatus used in experimental work, and to leave clean and in working order all machinery and apparatus with which they may experiment. All breakages, accidents or irregularities of any kind must be reported immediately to the head of the department or instructor in charge.

In case of either day or evening students, irregular attendance, lack of punctuality, neglect of either school or home work, disorderly or ungentlemanly conduct or general insubordination are considered good and sufficient reasons for the immediate suspension of a student, and a report to the trustees for such action as they deem necessary to take.

It is the aim of the trustees so to administer the discipline of the school as to maintain a high standard of integrity and a scrupulous regard for trust. The attempt of any student to present, as his own, work which he has not performed,

or to pass any examination by improper means, is regarded by the trustees as a most serious offence, and renders the offender liable to immediate suspension or expulsion. The aiding or abetting of a student in any dishonesty is also held to be a grave breach of discipline.

Any student who violates these provisions will be immediately suspended by the president, and the case reported at the following meeting of the trustees for action.

Examinations. — For first-year students intermediate examinations are held every five weeks, and these serve to inform the student concerning his standing and the progress made.

For students in upper classes informal examinations will be held during the eighth week of each term.

Formal examinations are held at the end of each term.

In general, the examinations cover the work of the preceding term, but at the discretion of the instructor may include work of earlier terms.

Examinations for students conditioned in first-term subjects are held during the second term, and examinations for students conditioned in the second-term subjects are held in September following. Students requesting condition examinations at other than scheduled dates will be required to pay $5 for each examination so taken.

Any student who fails to complete a subject satisfactorily or to clear a condition at the time appointed, will be required to repeat the subject, and he cannot be admitted to subjects dependent thereon.

A student whose term's standing is as a whole so low that he cannot continue with profit the work of the next term will be required to leave school, but he may return the following year to repeat such subjects as are required.

Daily work and regularity of attendance are considered in making up the reports of standing.

Continued or persistent absence or tardiness from the classes is considered reason to exclude a student from the class.

Records and Reports of Standing. — During each term informal reports are sent to parents or guardians of all students under age, and to all students; and at the end of each term formal reports are made.

The daily work of the student forms an important part of his record, and no pupil will be awarded the diploma or degree unless this portion of his record is clear.

Books are prescribed for study, for entry of lecture notes and other exercises, and are periodically examined by the lecturers. The care and accuracy with which these books are kept are considered in determining standing.

Thesis. — Each candidate for the degree of the school must file with the head of the department in which the thesis is taken, and not later than May 15, a report of original investigation or research, written on a good quality of paper, 8½ by 11 inches, with 1-inch margin at left, and one-half inch at right, of each page; such thesis to have been previously approved by the head of the department in which it is made.

For all candidates for the diploma this requirement will be optional on the part of the school.

Library and Reading Room. — That the students may have surroundings conducive to reading and study a moderate-sized reading room with library tables and chairs has been provided. The library shelves contain textile, art, engineering and scientific publications. These are increased from time to time as new technical books of value to textile students are issued from the press. The leading textile papers are kept on file for ready reference.

FEES, DEPOSITS, ETC.

Tuition Fee.—The fee for the day course is $150 per year for residents of Massachusetts. For non-residents the fee for all courses is $200 per year. The fee for students from foreign countries is $300 per year.

Three-fifths of the fee is charged for a single term. Each term's tuition is payable during the first week of that term. Students failing to make this payment at the specified time will be excused from classes until satisfactory explanation and

arrangements for payment can be made. *No bills will be sent.* After payment is made no fee or part thereof can be returned, except by special action of the trustees.

Special students pay, in general, the full fee, but if a course be taken involving attendance at the school during a limited time, application may be made to the president for a reduction.

Athletic Fee.—An athletic fee of $15 is due and payable at the time of the first payment of tuition.

Deposits.—For all first-year students a minimum deposit of $25 is required to cover the cost of breakage, supplies, apparatus and chemicals used in the Chemical Laboratory, the unexpended balance to be returned to the student at the end of the year. For all students in second, third and fourth years taking work in Chemistry and Dyeing Laboratories a deposit of $25 for the first term and $25 for the second term is required.

Students taking Machine Shop will be required to make deposit of $15 to cover cost of materials, supplies and breakage. Included in this charge is a kit of tools which is essential to the work and which becomes the personal property of the student. The unexpended balance will be returned at the end of the year.

Students not taking Chemistry Laboratory or Machine Shop will be required to make a deposit of $10 each year to cover general breakage. The unexpended balance will be returned at the end of the year.

All deposits must be made before students can be admitted for laboratory work.

Rooms and Board.—Students from a distance, requiring rooms and board in the city, may, if they desire, select same from a list which is kept at the school. The cost of rooms and board in a good district is $12 per week and upwards.

Books and Materials.—Students must provide their own books, stationery, tools, etc., and pay for any breakage or damage that they cause. The above fee includes free admission for any day students desiring to attend any of the evening classes in which there is accommodation.

All raw stock and yarn provided by the school, and all the productions of the school, remain, or become, the property of the school, except by special arrangement; but each student is allowed to retain specimens of yarn or fabrics that he has produced, if mounted and tabulated in accordance with the requirements of the school. It is understood that the school may retain such specimens of students' work as they may determine.

Lockers are provided for the use of the students, sufficiently capacious to contain clothing, books and tools.

No books, instruments or other property of the school are loaned to the students to be removed from the premises except by special permission.

Summary of Expenses per Year

Tuition (citizens of Massachusetts)	$150
Tuition (citizens of other states)	200
Tuition (foreigners)	300
Chemistry laboratory deposit (1st year)	25
Chemistry laboratory deposit (2d, 3rd and 4th years)	50
Machine shop deposit	15
General breakage fee	10
(This applies to students who do not take chemistry or machine shop.)	
Books and supplies	50
(Books and supplies for the first year cost about $80, second and third year $35, and fourth year $50, thus averaging about $50 per year for the four years.)	

SCHOLARSHIPS AND PRIZES

The Massachusetts Charitable Mechanic Association Scholarship.—The Massachusetts Charitable Mechanic Association has offered six scholarships of $250 each which are for the purpose of defraying school expenses of such students as may be selected by a committee composed of a representative from the Association, one from the Board of Trustees and the President of the School.

Herbert A. Currier Prize.—Herbert A. Currier, of the class of 1906, has offered a prize of $100 to a student who may be selected by the faculty of the school, and in making the selection the following conditions will be considered: scholastic standing, financial need, and ability in promoting student activities in school life. The scholarship will be awarded to a member of the sophomore, junior or senior class.

Edward A. Bigelow Prize. — Edward A. Bigelow, class of 1906, has offered the following cash prizes: $100 to the member of the class graduating from the Wool Manufacturing course who maintains the highest standing throughout his three years; $50 to the member of the second year class in the Wool Manufacturing course who maintains the highest standing during his second year; $25 to the member of the first year class in the Wool Manufacturing course who maintains the highest standing during his first year.

Textile Colorist Award. — The Textile Colorist, Inc., has offered a prize of $100 to be awarded to a member of the graduating class whose thesis, based upon his personal researches and experiences, is of the greatest practical value to the dyeing, bleaching or textile finishing industries.

Louis A. Olney Book Prize.—Prizes in the form of books are awarded each year to the successful candidates on graduation day. The conditions in detail are as follows: —

First. —Ten dollars to the student taking the regular Chemistry and Textile Coloring Course who shall be considered as having attained the highest scholarship in first-year chemistry.

Second. — Five dollars to the student taking the regular Chemistry and Textile Coloring Course, who shall be considered as having attained the second highest scholarship in first-year chemistry.

Third. — Ten dollars to the regular student of the Chemistry and Textile Coloring Course who shall be considered as having obtained the highest scholarship during his second year.

Fourth. — Five dollars to the regular student of the Chemistry and Textile Coloring Course who shall be considered as having attained the second highest scholarship during his second year.

Fifth. — Twenty dollars to the regular student in the Chemistry and Textile Coloring Course who shall present the best thesis preparatory to graduation.

The above-mentioned sums are to be invested in books which may be selected after graduation. In case no one is considered worthy of any particular scholarship prize, or if there is no competition, the same may be withheld. The decision in such case shall rest with the judges.

The National Association of Cotton Manufacturers Medal.—The National Association of Cotton Manufacturers offers a medal to that member of the graduating class who, during his course, shall have attained the highest standing in special subjects required by the vote of the association.

STUDENT ACTIVITIES AND ORGANIZATIONS

School Publications.—The Text is issued bi-weekly and it contains news pertaining to activities in the school as well as information concerning alumni. The Pickout is an annual publication in charge of a manager and editor selected from the senior class. The board is composed of representatives from the various classes.

Fraternities.—There are four fraternities, three of which are national and one is local. They afford opportunity for social life desired in a college career.

Musical and Dramatic Clubs.—The past four years the students have had a well organized orchestra and glee club which have given very enjoyable programs within and without the city. This offers an opportunity for pleasure and profit to students who enjoy music either vocal or instrumental. The Dramatic Club gives annually a theatrical program at the Lowell Auditorium. Appropriation is made from the profits to the Treasury of the Athletic Association.

Professional Clubs.—A Student Section of the American Society of Mechanical Engineers holds meetings regularly in accordance with requirements of the national organization. The Student Section of the American Society of Dyers and Colorists hold meetings at which papers are delivered or speakers come from

Cotton Yarn Department

outside the school organization. There is one Honor Society known as Tau Epsilon Sigma. Its membership is composed of students who have for the first three years maintained a particularly high scholastic standing.

Honor Roll.—The President's List includes upperclassmen taking a regular course who have a general average of eighty percent and no deficiencies.

Cooperative Society.—This society is maintained for the benefit of students who desire to purchase supplies and materials for use in connection with their work. It is operated under the direction of a Manager and Assistant Manager and one or more clerks. The general business policy is under the supervision of a member of the faculty. Students who join the society are entitled to discount privileges when purchasing from the society and from certain firms in the city of Lowell.

Alumni Association.—The Alumni Association of the School holds its annual meeting and banquet in May of each year in Lowell, Mass.

The membership of the association is composed of graduates of the day school and is open to any non-graduate who has attended the school for at least one year. Honorary membership is open to the Board of Trustees, the faculty and such others as may be elected by the association.

Officers for the Year 1927-28

Harold W. Conant, '09, *President.*
William O. Jelleme, '10, *Vice-President.*
Arthur A. Stewart, '00, *Secretary-Treasurer.*

Communications should be addressed to Arthur A. Stewart, Lowell Textile School.

Ex-Officio Members of Executive Committee

Edward M. Abbot, '04
Edward A. Bigelow, '06
Henry A. Bodwell, '00
Thomas T. Clark, '10
William R. Moorhouse, '01
T. Ellis Ramsdell, '02
Royal P. White, '04

Executive Committee

15 Members

Philip H. Warren, '05, *Chairman*
James F. Dewey, '04
Leonard S. Farr, '08
Russell T. Fisher, '14
Harold B. Frost, '12
Olin D. Gay, '08
Arthur J. Hennigan, '06
Parker W. Longbottom, '21
Brackett Parsons, '20
Everett B. Rich, '11
Irving N. Stronach, '10
Ernest D. Walen, '14
J. Milton Washburn, '21
A. Edwin Wells, '20
Stanley H. Wheelock, '05

Note.—Officers and Alumni Trustees are *ex-officio* members of Executive Committee.

SUBJECTS OF INSTRUCTION

In the column headed "Hours of Exercise" the numbers represent for each particular subject the total hours required in school for a period of fifteen weeks.

The letter and number which follow the subjects indicate the department in which the subject is given and the number of the subject in that department. For detailed description of the same, see page 30.

The departments are indicated as follows:—

Textile Engineering	B	Cotton Yarns	F
Chemistry and Dyeing	C	Woolen and Worsted Yarns	G
Textile Design and Power Weaving,	D	Finishing	H
Languages and History	E		

By referring to the letter and number indicated under "Preparation" the student can ascertain what subjects are necessary in order that he may have a clear understanding of the subject which he is scheduled to take.

First Year

First Term

[Common to all courses]

	Hours of Exercise
Mechanics B–11	60
Mechanical Drawing B–14	90
Mathematics B–10	45
Textile Design and Cloth Analysis D-10	90
Elementary Chemistry C–10	165
English E–10	45
Physical Education	30

Second Term

	Course IV	Course VI
Mechanism B–12	60	60
Machine Drawing B–15 and B–15a	30	90
Mechanical Laboratory B–13	–	30
Mathematics B–10	45	45
Textile Design and Cloth Analysis D–10	–	60
Elementary Chemistry C–10	75	75
Technology of Fibers F–10, G–10 and C–11	60	60
English E–10	45	45
Elementary German E–11 or Elementary French E–12	30	30
Qualitative Analysis C–12	135	–
Stoichiometry C–13	15	–
Physical Education	30	30

For second-term subjects in Courses I, II and III, see pages 21, 23, 25.

Course I — Cotton Manufacture

The Cotton Manufacturing Course is designed for students contemplating a career in the manufacturing of cotton yarns and cloth or allied industries, and wishing to devote but three years to the school work.

During the first term the studies are common to all courses, and include instruction in mechanism, mathematics, mechanical drawing, textile design and elementary chemistry. Laboratory work supplements the lectures in chemistry, and weaving assists in illustrating the principles of textile design. At the commencement of the second term instruction in the preliminary processes of yarn manufacturing is given in the course of technology of fibers.

The work in the Cotton Yarn Department comprises instruction in all the manufacturing processes from the bale to the finished yarn. The instruction is given by means of lectures upon the machines and processes, and by laboratory work upon the machines themselves. In the laboratory each student is required to make exhaustive tests upon each machine, and to make as many settings and adjustments as possible. The third year's work in this department is largely devoted to lectures upon the manufacture of specialties, waste products, etc., and special laboratory work, special tests upon yarns and fabrics, mill planning with regard to the arrangement of machinery, and other work of an advanced nature.

The course in chemistry consists of lecture and laboratory work on inorganic and organic chemistry, followed by a lecture course of instruction in textile chemistry and dyeing.

The work in mechanism serves as a basis for all future machine and mechanical work, and is followed by steam engineering, electricity and mill engineering. The mechanical drawing taken in connection with these subjects augments this instruction as well as provides opportunity for students to become skilled in drafting.

The course in textile designing, cloth analysis and cloth construction includes lectures on plain and fancy weaves and Jacquard work, the analysis of all commercial fabrics, and designs for the same. During the third year of this course students in this department specialize on cotton fabrics.

Power weaving is taken up during the second and third years. Commencing with lectures and practice upon plain looms, the student is taken through dobby and box-loom weaving and Jacquards.

A course in knitting taken during the third year includes the manufacture of hosiery and underwear. The course on the finishing of cotton fabrics is given by lectures and laboratory work, and requires considerable work on standard machines in the laboratory.

For detailed description of the subjects see page 32.

Course I. — Cotton Manufacture

[For first term see page 18]

First Year. Second Term. (Hours of Exercise)

Mechanism B-12	60	Technology of Fibers F-10, G-10, C-11	60
Machine Drawing B-15	75	Elementary Chemistry C-10	75
Mathematics B-10	45	English E-10	45
Textile Design and Cloth Analysis D-10	135	Physical Education	30

Second Year. First Term

Cotton Yarn Mfg. F-20	195	Machine Drawing B-21	30
Textile Design and Cloth Analysis D-20	75	Steam Engineering B-24	45
Power Weaving D-22	90	Physics B-22	45
Chemistry and Dyeing Lect. C-21	30	Industrial History E-22	15

Second Year. Second Term

Cotton Yarn Mfg. F-20	210	Steam Engineering B-25a	15
Textile Design and Cloth Analysis D-20	60	Machine Drawing B-21	45
Power Weaving D-22	120	Physics B-22	45
Chemistry and Dyeing Lect. C-21	15	Industrial History E-22	15

Third Year. First Term

Cotton Yarn Mfg. F-30	195	Cotton Finishing H-31	75
Knitting F-31	60	Electricity B-34a	30
Textile Testing G-31	15	Mill Engineering B-35a	30
Power Weaving D-31	120		

Third Year. Second Term

Cotton Yarn Mfg. F-30	240	Cotton Finishing H-31	75
Knitting F-31	60	Textile Testing G-31	15
Power Weaving D-31	135	Thesis.	

Course II. — Wool Manufacture

The course on wool manufacturing is arranged for those who contemplate a career in the manufacture of woolen or worsted fabrics, and can devote but three years to the school work. It includes instruction on all of the varied processes employed in manipulating the wool fiber to produce yarn and cloth, namely, sorting, scouring, carding, combing, spinning, designing, weaving, dyeing and finishing. The work is carried on by lectures, recitations and practical work in the laboratories.

Following the first term of the first year, which is common to all courses, the student taking technology of fibers becomes acquainted not only with the various kinds of wool and trade terms applied to them, but also with other commercial fibers, viz., cotton silk, jute, hemp, flax, etc., used in the textile industry. He is at the same time taught the application of these fibers and the general processes of manufacturing each into a yarn.

Beginning with the second year the details of manipulating wool from the grease to the finished yarn is taken up for close study. This includes the spinning of woolen yarn, also worsted yarn, by both the English and the French systems. The intermediate processes of sorting, scouring, carding, combing and top-manufacturing are taken in detail and in proper sequence.

The general chemistry of the first year is followed by a lecture course in the second year on textile chemistry and dyeing.

Textile design, cloth analysis and construction are continued from the first year throughout the course, the work being applied especially to woolen and worsted goods. Weaving on power looms commences in the second year and continues through the third.

Lectures on finishing commence with the third year and are augmented by extensive practice with the machines in the Finishing Department.

Work in the Engineering Department extends throughout all three years, and includes mechanical drawing, steam engineering and electricity. The practical application of the principles studied in these subjects is brought out forcibly in the work on mill engineering, where mill design and construction are considered. A short course covering methods employed in the testing of fibers, yarns and cloths, together with laboratory work in the manipulation of certain physical apparatus, is given in the third year.

For detailed description of the subjects see page 32.

Course II. — Wool Manufacture

[For first term see page 18]

First Year. Second Term. (Hours of Exercise)

Mechanism B-12	60	Technology of Fibers G-10, F-10, C-11	60
Machine Drawing B-15	75	Elementary Chemistry C-10	75
Mathematics B-10	45	English E-10	45
Textile Design and Cloth Analysis D-10	135	Physical Education	30

Second Year. First Term

Top Manufacture G-20	210	Machine Drawing B-21	30
Textile Design and Cloth Analysis D-21	90	Steam Engineering B-24	45
Power Weaving D-22	60	Physics B-22	45
Chemistry and Dyeing Lect. C-21	30	Industrial History E-22	15

Second Year. Second Term

Top Manufacture G-20	255	Steam Engineering B-25a	15
Textile Design and Cloth Analysis D-21	60	Machine Drawing B-21	45
Power Weaving D-22	75	Physics B-22	45
Chemistry and Dyeing Lect. C-21	15	Industrial History E-22	15

Third Year. First Term

Yarn Manufacture G-30	195	Electricity B-34a	30
Knitting F-31	60	Mill Engineering B-35a	30
Power Weaving D-31	120	Textile Testing G-31	15
Finishing H-30	75		

Third Year. Second Term

Yarn Manufacture G-30	255	Power Weaving D-31	120
Knitting F-31	60	Finishing H-30	75
Textile Testing G-31	15	Thesis.	

Course III. — Textile Design

The general course in textile design is planned to meet the demand of young men for a technical training in the general processes of textile manufacturing, but with particular reference to the design and construction of fabrics. To this end a foundation is laid in the first year by instruction in the elementary principles of designing, decorative art and weaving. That he may later in the course pursue to advantage instruction in yarn manufacturing, weaving, dyeing, finishing and some engineering problems, a foundation course in mechanics, mathematics and chemistry is laid. As the student is required to pursue courses in the yarn departments, both cotton and wool, he acquires a knowledge of the manufacture of cotton yarns from the bale to the yarn, and of woolen and worsted yarns from the fleece through the varied processes of manufacturing woolen yarn or worsted yarn by both the French and Bradford systems.

Throughout his entire course he receives instruction in design, cloth analysis and construction of all the standard cloths, viz., trouserings, coatings, suitings, blankets, velvets, corduroys, plushes, etc. This is followed by advanced work in Jacquard designing and weaving, which serves not only to acquaint the student with the many kinds of cotton, woolen, worsted and silk fabrics of figured design, but stimulates and develops any artistic talent he may possess. Decorative art becomes an important part of the work of the second and third years.

The course in general inorganic and organic chemistry of the first year leads to the subject of textile chemistry and dyeing in the second year.

Power weaving commences with the second year and continues throughout the course, and work on all types of looms is required.

During the third year the student receives instruction in the finishing of cotton goods and woolen and worsted cloths. This instruction is given by means of lecture and laboratory work.

The engineering subjects given in the second and third years are intended to acquaint the student with such general knowledge as will be of assistance should he be called upon in later life to be a mill manager, or should his subsequent progress lead to some executive position in the operation of a textile plant.

For detailed description of the subjects see page 32.

Course III. — Textile Design

[For first term see page 18]

First Year. Second Term. (Hours of Exercise)

Mechanism B–12	60	Tech. of Fibers F–10, G–10 and C–11	60
Machine Drawing B–15	75	Elementary Chemistry C–10	75
Mathematics B–10	45	English E–10	45
Textile Design and Cloth Analysis D–10	135	Physical Education	30

Second Year. First Term

Textile Design and Cloth Analysis D–20, 21	150	Machine Drawing B–21	30
Cotton Yarn Mfg. F–20	150	Steam Engineering B–24	45
Power Weaving D–22	60	Physics B–22	45
Chemistry and Dyeing Lect. C–21	30	Industrial History E–22	15

Second Year. Second Term

Textile Design and Cloth Analysis D–20, 21	135	Top Manufacture G–20	105
Cotton Yarn Mfg. F–20	75	Steam Engineering B–25a	15
Power Weaving D–22	75	Physics B–22	45
Chemistry and Dyeing Lect. C–21	15	Industrial History E–22	15
		Machine Drawing B–21	45

Third Year. First Term

Textile Design and Cloth Construction D–30	120	Power Weaving D–31	75
Yarn Manufacture G–30	90	Wool Finishing H–30	75
Mill Engineering B–35a	30	Cotton Finishing H–31	75
Knitting F–31	15	Electricity B–34a	30
		Textile Testing G–31	15

Third Year. Second Term

Textile Design and Cloth Construction D–30	180	Wool Finishing H–30	75
Yarn Manufacture G–30	90	Cotton Finishing H–31	75
Knitting F–31	15	Textile Testing G–31	15
Power Weaving D–31	75	Thesis.	

Course IV. — Chemistry and Textile Coloring

The four-year Course in Chemistry and Textile Coloring, leading to the degree of B.T.C., is especially intended for those who wish to engage in any branch of textile chemistry, textile coloring, bleaching, finishing or the manufacture and sale of the dyestuffs or chemicals used in the textile industry. The theory and practice of all branches of dyeing, printing, bleaching, scouring and finishing are taught by lecture work supplemented by a large amount of experimental laboratory work and actual practice in the dyehouse and finishing room.

The underlying theories and principles of chemistry are the same, no matter to what industry the application is eventually made. Furthermore, no industry involves more advanced and varied applications of the science of chemistry than those of the manufacture and application of the coal-tar coloring matters. In addition, the textile colorist must consider the complex composition of the textile fibers, and the obscure reactions which take place between them and the other materials of the textile industry.

During the first year general chemistry, including both inorganic and organic, is taught by lectures and laboratory work, and this is supplemented during the second term by qualitative analysis and stoichiometry.

Advanced inorganic chemistry, as well as advanced organic chemistry, is studied during the second and third year as a continuation of the elementary chemistry of the first year, and much time is spent upon quantitative analysis, industrial chemistry, and textile chemistry and dyeing.

The foundation work in general chemistry is continued during the third year with courses in physical chemistry, organic laboratory work and analytical work. The subject of industrial chemistry is introduced, and much time is devoted to advanced textile chemistry, dye testing, color matching, calico printing and woolen, worsted and cotton finishing.

The fourth year is characterized by an endeavor to present certain subjects of a more applied nature in such a manner that the student's reasoning power and ability to apply the knowledge gained during the first three years may be developed to the fullest extent. The subject of engineering chemistry is introduced, and the work in the Dyeing and Analytical Laboratories is applied as far as possible to the actual requirements of the factory chemist and colorist. The student is given a thorough course in microscopy, photomicrography and the use of the various instruments, such as the spectroscope, ultra-microscope, polariscope, tintometer, etc., which often prove of vital importance in the advanced study of textile chemistry. During this fourth year the student devotes much time in the Organic Laboratory in the manufacture of dyestuffs. This is followed by some research work or original investigation as time will permit. Upon this he must present a satisfactory thesis, or report, before receiving his degree.

For detailed description of the subjects see page 32.

Course IV. — Chemistry and Textile Coloring

[For first year see page 18]

Second Year. First Term. (Hours of Exercise)

Adv. Inorganic Chemistry C–23	30	Quantitative Analysis C–25	195
Textile Chemistry and Dyeing Lect. C–21	30	Steam Engineering B–24	45
Chemistry and Dyeing Lab. C–22	75	Physics B–22	45
Stoichiometry C–20	15	Industrial History E–22	15
		Advanced German E–21	30
		Mathematics B–20	45

Second Year. Second Term

Adv. Inorganic Chemistry C–23	30	Quantitative Analysis C–25	150
Chemistry and Dyeing Lect. C–21	15	Adv. Organic Chemistry C–24	30
Chemistry and Dyeing Lab. C–22	135	Physics B–22	45
Stoichiometry C–20	15	Industrial History E–22	15
Mathematics B–20	45	Advanced German E–21	30
		Steam Engineering B–25a	15

Third Year. First Term

Adv. Textile Chemistry and Dyeing Lect. C–32	30	Adv. Organic Chemistry Lect. C–36	30
Adv. Textile Chemistry and Dyeing Lab. C–32	135	Technical German C–35	30
Industrial Chemistry C–31	30	Wool Finishing H–30	75
Quantitative Analysis C–30	165	Economics E–30	30

Third Year. Second Term

Adv. Textile Chemistry and Dyeing Lect. C–32	15	Physical Chemistry C–33	30
Adv. Textile Chemistry and Dyeing Lab. C–32	75	Technical German C–35	30
Industrial Chemistry C–31	30	Organic Laboratory C–34	120
Wool Finishing H–30	75	Quantitative Analysis C–30	120
		Economics E–30	30

Fourth Year. First Term

Physical Chemistry C–44	45	Quantitative Analysis C–47	15
Technical German C–40	30	Dyeing Laboratory C–45	135
Engineering Chemistry C–42	15	Organic Laboratory C–41	90
Adv. Textile Chemistry and Dyeing C–45	30	Industrial Laboratory C–43	45
Textile Testing G–31	15	Thesis C–48	105

Fourth Year. Second Term

Physical Chemistry C–44	15	Adv. Textile Chemistry and Dyeing C–45	15
Organic Laboratory C–41	105	Technical German C–40	30
Microscopy C–46	45	Engineering Chemistry C–42	30
Dyeing Laboratory C–45	90	Thesis C–48	180
Textile Testing G–31	15		

Course VI. — Textile Engineering

This course is the four-year general textile course leading to the degree of Bachelor of Textile Engineering (B.T.E.), and aims especially to fit men, in the broadest possible manner, to meet the increasing demands of every branch of the textile industry for men with combined textile and technical preparation. The magnitude and scope of the textile and allied industries fully justify the most thorough technical training possible for all who aspire to leadership in this field.

The student is first thoroughly grounded in those fundamental principles of science upon which all industrial and engineering work rests. The foundation of his textile and technical training is in the subjects of mathematics, physics, chemistry, drawing, mechanics, mechanism, and technology of fibers, and their practical application.

Instruction is given in all of the various branches of textile manufacturing through lectures, recitations and laboratory work. A large proportion of his time is spent in well-equipped textile departments where he studies and operates all of the machinery required in the conversion of cotton and wool fiber into yarns and fabrics. This includes cotton, wool and worsted yarn manufacturing, designing, weaving, knitting, dyeing and finishing. In his last year the course in textile testing acquaints the student with the methods for determining the physical properties of textile fibers, yarns and fabrics.

To properly equip the student to meet the varied engineering problems which confront the mill manager or executive, or to so train him that he may enter those industries closely allied to the textile, instruction is given by lecture and laboratory practice in the several branches of engineering.

Steam engineering considers the problems involved in steam generation and distribution for power, heating and manufacturing purposes, includes the testing of laboratory and power plant equipment, and leads to the design of power plants. The course in electrical engineering includes a study of the generation and transmission of electrical power, the testing of direct and alternating current machinery, and is intended to acquaint the student with modern practice.

Mill engineering familiarizes the student with mill design, construction, heating, lighting, humidification and fire protection. The arrangement of machinery and buildings for most efficient production and economical power distribution is also studied in detail.

During the fourth year the student is required to conduct an original investigation of some textile or allied problem, and to submit the results in the form of a satisfactory thesis before receiving his degree.

The broadening effect of such subjects as English, language, industrial history and economics is carried still further in this course by carefully planned courses in business administration, accounting, cost accounting, business and patent law.

For the student who may desire the breadth of technical training which this course offers, but who wishes to specialize in either cotton or wool manufacturing, two options are offered. In these optional courses the student's entire textile time is devoted to the study of that particular fiber which he elects.

For detailed description of subjects, see page 32.

Course VI. — Textile Engineering (General Course)

[For first year see page 18]

Second Year. First Term. (Hours of Exercise)

Chemistry and Dyeing Lect. C–21	30	Engineering Lab. B–26	45
Physics B–22	45	Cotton Yarn Mfg. F–20	45
Mathematics B–20	45	Wool Yarn Mfg. G–20	120
Machine Drawing B–21	75	Language E–20, 21	30
Steam Engineering B–24	45	Industrial History E–22	15
Power Weaving D–22	30		

Second Year. Second Term

Physics B–22	45	Industrial History E–22	15
Mathematics B–20	45	Power Weaving D–22	30
Machine Drawing B–21	75	Chemistry and Dyeing Lect. C–21	15
Steam Engineering B–25	30	Graphic Statics B–23	30
Yarn Mfg. F–20 and G–20	165	Engineering Lab. B–26	45
Language E–20, 21	30		

Third Year. First Term

Electrical Engineering B–34	75	Power Weaving D–31	45
Engineering Lab. B–31	45	Mathematics B–30	30
Cotton Yarn Mfg. F–30	60	Mill Engineering B–35	45
Wool Yarn Mfg. G–30	90	Wool Finishing H–30	75
Strength of Materials B–32	30	Economics E–30	30

Third Year. Second Term

Hydraulics B–33	15	Wool Finishing H–30	75
Electrical Engineering B–34	75	Power Weaving D–31	45
Mill Engineering B–35	45	Mathematics B–30	30
Machine Shop Practice B–36	30	Strength of Materials B–32	30
Yarn Mfg. F–30 and G–30	150	Economics E–30	30

Fourth Year. First Term

Cotton Organization F–40	75	Power Plants B–42	30
Machine Shop Practice B–40	45	Business Administration B–44	45
Mill Engineering B–43	75	Elements of Accounting B–46	45
Electrical Engineering B–41	75	Thesis	75
Cotton Finishing H–31	30	Electives B–49	
Textile Testing G–31	15	Knitting F–31	15

Fourth Year. Second Term

Mill Engineering B–43	75	Knitting F–31	15
Electrical Engineering B–41	75	Business Administration B–44	30
Cotton Finishing H–31	75	Cost Accounting B–47	45
Power Plants B–42	30	Business Law B–48	15
Textile Testing G–31	15	Thesis	135
Cotton Organization F–40	15	Electives B–49	

Course VI. — Textile Engineering (Cotton Option)

[For first year see page 18]

Second Year. First Term. (Hours of Exercise)

Chemistry and Dyeing Lect. C–21	30	Steam Engineering B–24	45
Physics B–22	45	Cotton Yarn Mfg. F–20	165
Mathematics B–20	45	Language E–20, 21	30
Machine Drawing B–21	75	Industrial History E–22	15
Engineering Lab. B–26	45	Power Weaving D–22	30

Second Year. Second Term

Physics B–22	45	Power Weaving D–22	30
Mathematics B–20	45	Language E–20, 21	30
Machine Drawing B–21	75	Industrial History E–22	15
Steam Engineering B–25	30	Chemistry and Dyeing Lect. C–21	15
Yarn Mfg. F–20	165	Graphic Statics B–23	30
Engineering Lab. B–26	45		

Third Year. First Term

Electrical Engineering B–34	75	Engineering Lab. B–31	45
Mill Engineering B–35	45	Mathematics B–30	30
Yarn Mfg. F–30	90	Strength of Materials B–32	30
Cotton Design D–20	75	Economics E–30	30
Power Weaving D–31	30	Cotton Finishing H–31	75

Third Year. Second Term

Hydraulics B–33	15	Power Weaving D–31	90
Electrical Engineering B–34	75	Mathematics B–30	30
Mill Engineering B–35	45	Strength of Materials B–32	30
Yarn Mfg. F–30	75	Economics E–30	30
Cotton Design D–20	30	Cotton Finishing H–31	75
Machine Shop Practice B–36	30		

Fourth Year. First Term

Machine Shop Practice B–40	30	Business Administration B–44	45
Mill Engineering B–43	45	Elements of Accounting B–46	45
Electrical Engineering B–41	75	Electives B–49	
Cotton Organization F–40	75	Knitting F–31	60
Power Plants B–42	30	Thesis	75
Textile Testing G–31	15		
Textile Design D–30	30		

Fourth Year. Second Term

Cotton Organization F–40	45	Cost Accounting B–47	45
Mill Engineering B–43	75	Business Law B–48	15
Electrical Engineering B–41	75	Electives B–49	
Power Plants B–42	30	Knitting F–31	60
Business Administration B–44	30	Textile Testing G–31	15
Textile Design D–30	30	Thesis	105

Course VI. — Textile Engineering (Wool Option)

[For first year see page 18]

Second Year. First Term. (Hours of Exercise)

Chemistry and Dyeing Lect. C–21	30	Steam Engineering B–25	45
Physics B–22	45	Yarn Manufacture G–20	150
Mathematics B–20	45	Language E–20, 21	30
Machine Drawing B–21	90	Industrial History E–22	15
Engineering Lab. B–26	45	Power Weaving D–22	30

Second Year. Second Term

Physics B–22	45	Power Weaving D–22	30
Mathematics B–20	45	Language E–20, 21	30
Machine Drawing B–21	75	Industrial History E–22	15
Steam Engineering B–25	30	Chemistry and Dyeing Lect. C–21	15
Yarn Manufacture G–20	165	Graphic Statics B–23	30
Engineering Lab. B–26	45		

Third Year. First Term

Electrical Engineering B–34	75	Power Weaving D–31	45
Mathematics B–30	30	Engineering Lab. B–31	45
Mill Engineering B–35	45	Strength of Materials B–32	30
Yarn Manufacture G–30	105	Economics E–30	30
Woolen and Worsted Finishing H–30	75		

Third Year. Second Term

Hydraulics B–33	15	Woolen and Worsted Finishing H–30	75
Electrical Engineering B–34	75	Power Weaving D–31	90
Mill Engineering B–35	45	Mathematics B–30	30
Machine Shop Practice B–36	30	Strength of Materials B–32	30
Economics E–30	30		
Yarn Manufacture G–30	105		

Fourth Year. First Term

Machine Shop Practice B–40	30	Textile Testing G–31	15
Mill Engineering B–43	75	Business Administration B–44	45
Electrical Engineering B–41	75	Elements of Accounting B–46	45
Worsted Yarn Manufacture G–2	75	Power Plants B–42	30
Woolen and Worsted Design, D–20	45	Thesis	75
Knitting F–31	15	Electives B–49	

Fourth Year. Second Term

Mill Engineering B–43	75	Cost Accounting B–47	45
Electrical Engineering B–41	75	Business Law B–48	15
Yarn Manufacture G–2	45	Power Plants B–42	30
Woolen and Worsted Design D–20	30	Thesis	135
Business Administration B–44	30	Electives B–49	
Textile Testing G–31	15	Knitting F–31	15

SUBJECTS OF INSTRUCTION

TEXTILE ENGINEERING DEPARTMENT — B

Mathematics — B–10. Preparation: Admission Requirements. The work in the first term consists of plane trigonometry, logarithms, and instruction in the use of the slide-rule. Right and oblique triangles are solved by means of natural and logarithmic functions, and the various algebraic relations among the trigonometric functions are proved and used in identities and equations. Significant figures and the use of approximate data in calculations are also discussed.

In the second term, the following topics are taken up: graphical and mathematical solution of quadratic and simultaneous equations, theory of equations, partial fractions, Naperian logarithms, equations of the straight line, and equations of various curves. [Courses IV and VI.]

Mathematics — B–10a. Preparation: Admission Requirements. This subject in the first term is identical with B–10, but excludes some of the topics given in the second term of B–10. [Courses I, II, III.]

Mathematics — B–20. Preparation: B–10. This subject is a continuation of the work of the first year course B–10, and extends throughout the second year of the engineering course. A study of the derivative is followed by the differentiation of algebraic functions and applications of the derivative to maximum and minimum and rate problems. Other topics treated are the circle, parabola, ellipse, hyperbola, indefinite integrals, summation by integration, areas, volumes and pressures.

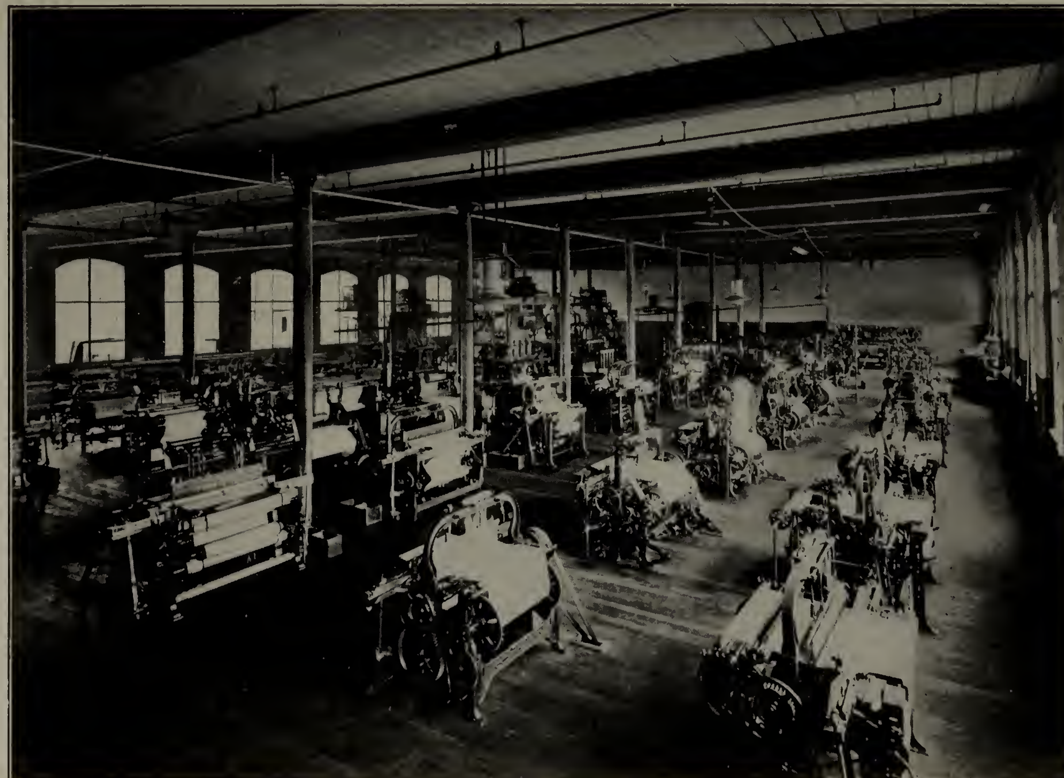
Mathematics — B–20a. Preparation: B–10a. The work in this subject is similar to the first year of B–20 and is given for students of chemistry and textile coloring. [Course IV.]

Mathematics — B–30. Preparation: B–20. During the third year, applications of calculus to mechanics are emphasized. The topics are as follows: integration by parts, integration by substitution, partial fractions, polar coordinates, centers of gravity, moments of inertia, radius of curvature, deflection of beams and empirical formulas. [Course VI.]

Mechanics — B–11. Preparation: Admission Requirements. Taken simultaneously with B–10. This subject is required as a necessary preparation for all courses, and sixty hours of lecture and recitation time are devoted to it during the first term of the first year. The fundamental principles of this subject are considered absolutely essential to a thorough understanding of the operation of all machinery, textile or otherwise. Some of the topics treated in this course are linear and angular velocity, uniform and accelerated motion, mass, momentum, inertia, effect of force in producing motion, centrifugal force, work, power, energy, principle of moments and its applications, parallelogram and triangle of forces with applications, resolution and composition of forces, the mechanical principles represented by the wheel and axle, differential pulley block, common pulley blocks, jackscrew, worm and wheel, and inclined plane. [All courses.]

Mechanism — B–12. Preparation: B–10 and B–11. This subject is also deemed to be one of those absolutely essential to every student's preparation for the work of the following years, and sixty hours during the second term of the first year are allowed for it. Whereas the principles studied are of general application, textile machinery in particular furnishes an unusually large variety of specific examples, and frequent reference is made to these in the development of the course. Some of the important topics covered are gearing and gear train design, belting and pulley calculations, cone and stepped pulley design, cam design, linkages, epicyclic gear trains, and intermittent motion devices. [All courses.]

Mechanical Laboratory — B–13. Preparation: B–10 and B–11. Taken simultaneously with B–12. This work is given during the second term of the first year, and is supplementary to the course in Mechanics and Mechanisms. Especial importance is attached to the demonstration of the fundamental principles of these



Weave Room

subjects. Some of the experiments and tests made in this course are as follows: —

Determination of coefficient of friction; proof of principle of moments; proof of principle of work; efficiency test of various hoisting and lifting appliances, such as tackle and fall, worm block, differential and triplex blocks, jackscrews, wedges, etc.; experimental proofs of the principles of graphic statics; efficiency tests on belt transmission, including measurement of belt tensions, coefficient of friction, slip, etc.

Tests on various types of absorption dynamometers; calibration of transmission dynamometer; power measurements on textile machinery with differential dynamometer; measurement of friction of steam engine. [Course VI.]

Mechanical Drawing — B–14. Preparation: Admission Requirements. Taken simultaneously with B–11. This course is taken during the first year, and consists of work in the drawing room supplemented by lectures. This subject is considered of the greatest importance as a preparation for the student's future work, and the practical usefulness of drawing of this character is fully emphasized. The course is systematically laid out covering in order the following divisions:—

Care and use of drawing instruments; geometrical constructions; elements of projections and descriptive geometry; isometric projection; developments with practical applications; sketching practice on machine details. [All courses.]

Machine Drawing — B–15. Preparation: B–14. This work is the continuation of Mechanical Drawing, and is pursued throughout the second term of the first year. This work is wholly of a practical character, and includes sketching from the textile machinery details, working scale detail and assembly drawing, tracing and blue printing. The rudiments of machine design to supplement the work in strength of materials is also given. [Courses I, II, III, VI.]

Machine Drawing — B–15a. Preparation: B–14. For students electing the Chemistry and Textile Coloring course in the second term of the first year a course of machine drawing is given similar to B–15, except that it is not as extensive and is concluded in thirty hours. [Course IV.]

Machine Drawing — B–21. Preparation: B–12, B–14, B–15. During the second year the work in Machine Drawing is devoted to advanced graphical mechanism problems. The data for all of these problems are in every case taken directly from some of the textile machines that the students meet in other departments. These problems include cam designs for builder motions, mule scroll layouts, Scaife builder motion analysis, fly frame cone design, mule quadrant motion, analysis of camless winder, and a number of others of similar character. [Courses I, II, III, VI.]

Physics — B–22. Preparation: B–10 and B–11. This subject lays the foundation for later work in engineering and chemistry and also explains the general application of the laws and principles of physics. Instruction, consisting of lectures, demonstrations, and recitations, is given for three hours per week during the second year. The topics taken up the first term are:—thermometry, measurement of heat, change of state, expansion, transfer of heat, humidity, hydrostatics, elements of hydraulics, the vernier, kinetic energy, circular motion, harmonic motion, wave motion and sound.

The second term is devoted to the study of light, magnetism, and electricity. Some of the topics are:—nature and propagation of light, reflection and refraction lenses, the telescope and microscope, the spectroscope, color sensation, double refraction, magnetism, electrostatics, fundamental laws of direct currents and electrolysis. [All courses.]

Graphic Statics — B–23. Preparation: B–10 and B–11. The work in this course is presented by lecture and recitations. First are considered mathematical and graphical conditions for equilibrium for any system of forces, and the subjects of center of gravity and funicular polygons are introduced. Then follow problems on bridge and roof trusses under various conditions of dead, live, wind and snow loading. [Course VI.]

Steam Engineering — B–24. Preparation: B–10, B–11, B–12. The purpose of this course is to familiarize the student with the principles of elementary thermodynamics, the properties of steam, mechanical mixtures, combustion of fuels, types of boilers, and the auxiliaries of the modern boiler house. The course con-

sists of forty-five exercises given in the first term of the second year. The lectures and recitations are supplemented with illustrative problems assigned for home preparation. [All courses.]

Steam Engineering — B–25. Preparation: B–24. This course is a continuation of B–24, and consists of thirty hours of lectures and recitations given in the second term of the second year of the Textile Engineering course. The subjects developed are the kinematics of reciprocating steam engines, steam turbines and gas engines. Special attention is given to the mechanical principles on which the steam engine operates, with detail discussion of the valve gear and governing devices, and the various diagrams used for studying the same. Consideration is given to the underlying heat theory and to the details of construction of the various parts of the machines. During the latter part of the course the historical development, classification and types of turbines and gas engines are discussed. [Course VI.]

Steam Engineering — B–25a. Preparation: B–24. This course consists of fifteen lectures and is supplementary to Course B–24. Its aim is to give those students who do not take the Engineering course a general knowledge of the steam engine, steam turbine and gas engine, and their auxiliaries. One exercise is devoted to an engine test to demonstrate the practical use of the indicator and the advantages of condensing. [Course I, II, III, IV.]

Engineering Laboratory — B–26. Preparation: B–24. The principles underlying the subjects of steam engineering, hydraulics and thermodynamics are demonstrated in a practical manner in the work in the Engineering Laboratory. Greater importance is attached to the development of initiative and responsibility in the student than the mere accomplishment of a large number of carefully planned tests. The character of this work is indicated by the following list of experiments and tests: —

Calibration of scales, tanks, gauges, inductors and counters; barrel, separating, and throttling calorimeter tests; heat exchange tests; boiler inspection and measurement; flue gas analysis; dynamometer tests; ejector and injector tests; Rankin's efficiency, actual thermal efficiency and duty tests; expansion of pipes, radiation and pipe covering tests; boiler test; trap tests, feed water heating tests; steam, triplex and centrifugal pump tests. [Course VI.]

Engineering Laboratory — B–31. Preparation: B–26. This course is a continuation of course B–26. The following list of experiments indicates the character of the work done during the first half of the third year: —

Valve setting by measurement and by indicator; condenser test; non-condensing and condensing engine and turbine tests; heating and ventilating fan tests; lap and butt riveted joint tests; nozzle test; gas engine test, flow of air and air compressor tests. [Course VI.]

Strength of Materials — B–32. Preparation: B–12, 20, B–23. This subject consists of sixty exercises given in the third year of the Textile Engineering course, and in which are discussed, as fully as time permits, such topics as stress, strain, methods of testing materials, bending moments, shearing force, beam design, column design, torsion, design of shafts, compound beams and columns, combined stresses, etc. The subject is preparatory to the work in Mill Engineering of both the third and fourth years, where its practical value and application are clearly demonstrated. [Course VI.]

Hydraulics — B–33. Preparation: B–14, and B–20. This subject is presented by means of lectures covering the principles of hydraulics, including hydrostatics, measurements of flow of water through orifices, pipes, nozzles and over weirs. The different types of turbines are studied with results of tests and rating tables. [Course VI.]

Electrical Engineering — B–34. Preparation: B–22. The elementary principles of electricity and magnetism are considered in the lecture course of physics. Their development and application are taken up in this course in a detailed study of the magnetic and electric circuits during the first period of the first term. The second period is devoted to a study of the principles of direct current machinery. The laboratory work consists of a study of technical electrical measurements and dynamo-electric machinery, determining for the latter their operating characteristics.

The second term is devoted entirely to a study of the principles of alternating current circuits, including vector representation, effective values, power, series and parallel circuits. The laboratory work consists of a study of technical electrical measurements, some meter calibration including that of watt-hour meters and a study of alternating current circuits using electrical measuring instruments. [Course VI.]

Electricity — B–34a. Preparation: B–22. This is a short course given in the third year of the manufacturing courses, and consists of thirty lectures covering briefly and in a general way the theory of direct and alternating current generators and motors. [Courses I, II, III.]

Mill Engineering — B–35. Preparation: B–12, B–20, B–21, B–23, B–32. Mill Engineering, as presented in thirty lectures during the third year of the Textile Engineering course, consists of a discussion of the following topics: the selection of a site for a manufacturing plant; the exploration of the subsoils for the footing course of the foundation; wood, concrete and sheet steel piling; design of walls, columns, beams, floors, windows, doors, stairways and roofs.

Sixty hours of drawing room and laboratory practice are devoted to plane surveying, contour plotting, cut and fill calculations, setting of batter boards, alignments of shafting and the study from blue prints of slow-burning construction. [Course VI.]

Mill Engineering — B–35a. Preparation: B–10, B–12, B–21. Mill Engineering, as presented in thirty lectures during the third year of the diploma courses, is largely general in its nature and includes only parts of Course B–35. [Courses I, II, III.]

Machine Shop Practice — B–36. Preparation B–11, and B–12. Systematic instruction is given in the most approved methods of machine shop practice, the object being to familiarize the student with the proper use of hand and machine tools, and the characteristics of the different materials worked. Particular attention is given to the form, setting, grinding and tempering of tools and the mechanism of the different machines involving certain speeds, feeds, etc. The course is so planned that the instruction in each typical operation shall conform as nearly as possible to commercial machine-shop practice on textile machinery. The list of tools which appears under "Equipment" in this Bulletin gives an idea of the scope of the work, which includes chipping and filing, tool grinding and tempering, straight and taper turning, screw cutting, drilling and boring, planer work; milling machine work, including gear cutting. Instruction is also given in the use of woodworking tools, both hand and machine, and in forging. [Course VI.]

Machine Shop Practice — B–40. Preparation: B–36. This is a continuation of Course B–35.

Electrical Engineering — B–41. Preparation: B–34. During the first term a detailed study of the alternator is made, with particular stress on generation of three-phase currents. Methods of pre-determination of alternator regulation are taken up and at least one method compared with laboratory test. Parallel operation of alternators with accompanying instruments and devices are studied in class-room and laboratory. The single phase, three-phase and Scott transformers are considered in turn and their various methods of connecting to line and alternators are systematically studied.

In the second term the induction motor and generator are studied with their particular adaptability to the textile industry. The principal starting devices for this motor are thoroughly taken up. The synchronous motor is studied particularly in relation to its ability to correct power factor. In all the work outlined above, the main features are illustrated profusely in class-room demonstrations and laboratory exercises.

Mill Illumination: Fourteen lectures and six laboratory periods. The various factors entering into the design of lighting installations are carefully considered. Costs and estimates, safety and production, are included in the course.

The laboratory exercises include the study and applications of the photometer, Macbeth Illuminometer and foot-candle meter. The concluding work is the design of a lighting installation for a typical mill room, using the school laboratories for this purpose. [Course VI.]

Power Plants — B-42. Preparation: B-25. This course, which consists of lectures given during the fourth year, takes up the fundamental consideration involved in the planning of a power plant for a textile mill. A standard textbook is used in connection with the lectures, and the problems are taken largely from plans of existing modern plants. The choice of type and size of units for certain conditions are given particular attention. [Course VI.]

Mill Engineering — B-43. Preparation: B-11, B-12, B-21, B-36. This work, given in the fourth year of the Textile Engineering course, covers a wide range of subjects and is of the most practical character possible. All of the student's previous work in engineering and his knowledge of the textile processes are here brought together in the consideration of the larger problems of mill design, construction and organization. After a detailed study has been made of the most modern types of mill buildings, including all calculations and drawings, the student is given the problem of laying out and completely designing a textile mill so far as time permits.

The modern methods of power transmission and the proper arrangement of textile machinery are also given careful consideration. The problems are in every case taken from actual conditions in mills already built or in process of construction. The question of mill heating, ventilation, lighting, humidification and fire protection is also studied, and the time spent in the drawing room enables the student to work out nearly all of the more important problems involved in the design of an entire textile mill plant. The close relation existing between proper plant design and economical production is also considered. [Course VI.]

Business Administration — B-44. Preparation: B-10 and E-30. In recognition of the great advances which have been recently made towards better methods of management, and of the possibilities which may result from its application to the textile industry, a course in business administration has been established to enable the student to understand and apply the principles and details of modern management. The instruction in this course begins with a consideration of the factory location and design and their effect on efficiency of production, after which the proper form of organization for manufacturing establishments is discussed in detail, together with organization charts and records.

This is followed by a study of the details of the work of the various departments, such as purchasing, manufacturing, planning, etc., and includes such topics as purchasing systems, storeskeeping, perpetual inventories, warehousing, scheduling, routing, tracing, timekeeping, motion studies, time studies, mnemonic symbolizing, graphical records, wage systems, etc. Consideration is also given to the important relation of psychology to efficient management. The work is further supplemented by visits to plants where methods of production and management can be observed at first hand by the students. [Course VI.]

Elements of Accounting — B-46. Preparation: B-10 and E-30. The purpose of the course in accounting is to acquaint the student with modern methods of accounting for mercantile and manufacturing businesses. At the same time it gives him a much-needed knowledge of such common elementary business transactions as are involved in the use of checks, drafts, notes, vouchers, bonds and stocks.

It is not the purpose of the course to make the student a proficient bookkeeper or accountant, but the nature of the work necessitates a basic knowledge of double-entry bookkeeping and of the functions of ledger accounts. This is developed in practice in the following manner: During the summer preceding the fourth year the student is required to work up a simple bookkeeping set, thus saving valuable time during the school year and effectively preparing the ground for the instruction work.

The course includes a study of the balance sheet and profit and loss statement, and their construction in proper form. Attention is given to the principles of balance sheet valuation, and to such topics as depreciation in all its phases, sinking fund reserves, and the accounting for bond and stock issues. [Course VI.]

Cost Accounting — B-47. Preparation: B-46. The major portion of the time scheduled for accounting in the second term of the fourth year of the Textile Engineering course is devoted to a study of this important topic. It is designed to give the student a knowledge of the various cost methods in use at the present

time, and involves a thorough discussion of methods of handling and accounting for raw materials, direct labor, and the distribution of overhead expenses. To supplement the instruction, the student is required to work up a cost accounting set. [Course VI.]

Business Law — B-48. Preparation: E-30. Under this subject are given lectures, supplemented by the use of a suitable text, on the law governing contracts, negotiable instruments, sales, bills of lading, real estate and corporation. [Course VI.]

Electives — B-49. Students in the fourth year of the Textile Engineering course will be permitted to elect certain textile subjects as substitutes for part of the time scheduled for engineering subjects. Thus a student is offered an opportunity for specialized study along such lines as will prove most beneficial to him at that time. The selection of elective studies is subject to the approval of the head of the Textile Engineering department and to the possibility of arranging for the same. [Course VI.]

CHEMISTRY AND DYEING DEPARTMENT — C

Elementary Chemistry (Inorganic and Organic Chemistry) — C-10. Preparation: Admission Requirements. Instruction in Elementary Chemistry extends through the first year, and includes lectures, recitations and a large amount of individual laboratory work on the following subjects: —

Inorganic Chemistry

Non-Metallic Elements. — Their occurrence, properties, preparation, chemical compounds, etc.

Metallic Elements. — Their occurrence, properties, metallurgy, chemical compounds, etc.

Theoretical Chemistry. — Fundamental laws and the theories of chemistry including chemical action, chemical combination, combining weights, atomic weights, chemical equations, acids, bases, salts, Avogadro's law, molecular weights, formulæ, valence, periodic law, etc.

Throughout this course special attention is given to the relationship which exists between the science of chemistry and the properties of the materials used in the various industries and the chemical reactions depended upon for the maintenance of industrial processes.

The laboratory work of this course includes the experimental study of the above subjects and also a preliminary study of the qualitative detection of the more common metals and non-metals, preparatory to Course C-12.

Organic Chemistry

This course includes a general survey of the fundamental principles of Organic Chemistry, also a study of the hydrocarbons and their derivatives from the point of view of their structure, preparation and uses. This work, although elementary in character, is of sufficient breadth to prepare the student understandingly for the general lectures upon Coal Tar dyestuffs which are given in Course C-21.

Chemistry Technology of Fibres — C-11. The outline of the lecture course which is given during the second term of the first year is as follows: —

Technology of Vegetable Fibers. — Cotton, linen, jute, hemp, china grass. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Animal Fibers. — Wool, mohair, silk. Chemical and physical properties, chemical compositions, microscopical study, and their action with chemicals, acids, alkalies and heat.

Technology of Artificial Fibers. — Study of the various forms of artificial silk, the process of manufacture, their properties and action with chemicals, acids and heat. [All courses.]

Qualitative Analysis — C-12. Preparation: C-10 taken simultaneously. Qualitative Analysis is studied during the second term of the first year. The work consists of conferences and laboratory work. The student must become

familiar with the separations and the detections of the common metals and acids by the analysis of a satisfactory number of solutions, salts, alloys and pigments. At intervals during the term short laboratory tests are given as well as the regular written examinations.

No pains are spared to make the course as valuable to the student as possible, and to encourage only thorough and intelligent work.

When sufficiently advanced, students take up the examination of various products with which the textile chemist must be familiar such as testing mordanted cloths, pigments and the various dyeing reagents.

During the latter part of this course a certain amount of time is devoted to the preliminary operations of quantitative analysis, such as the precipitation and washing of such substances as barium sulphate, magnesium ammonium phosphate and calcium oxalate, although no weighings or actual determinations are made.

A student's marks in this subject depend as much upon the neatness and care used in manipulation as upon the actual results obtained. [Course IV.]

Stoichiometry — C–13. Preparation: B–10, C–10. This subject is taken two hours each week during the second half of the first year. The application of the metric system is thoroughly studied, and problems are worked involving the expansion and contraction of gases, determination of empirical formulæ, combining volume of gases and chemical calculations, especially those of quantitative analysis. [Course IV.]

Stoichiometry — C–20. Preparation: C–13. This is a continuation of Stoichiometry C–13, and is taken during the second year as an adjunct to Quantitative Analysis. [Course IV.]

Textile Chemistry and Dyeing — C–21. Preparation: C–10, B–12, B–14.

Operations Preliminary to Dyeing. — Bleaching of cotton and linen; wool-scouring; bleaching, fulling and felting of wool; carbonizing; silk-scouring and bleaching; action of soap.

The bleaching of cotton cloth, yarn and raw stock is studied at length with detailed description of the various forms of kiers and machinery used; also the action of the chemicals used upon the material, and the various precautions that must be taken in order to insure successful work.

Under this heading is also included an exhaustive study of the reagents used in the emulsive wool-scouring process, and their action upon the fiber under various conditions; also the most successful of the solvent methods for degreasing wool.

Water and Its Application in the Textile Industry. — Impurities present, methods for detection, their effect during the different operations of bleaching, scouring, dyeing and printing, and the methods used for their removal or correction.

The important subject of boiler waters is also studied under this heading, with a full discussion of the formation of boiler scale, its disastrous results, and the methods by which it may be prevented.

Mordants and Other Chemical Compounds Used in Textile Coloring and Classified as Dyestuffs. — Theory of mordants, their chemical properties and application, aluminum mordants, iron mordants, tin mordants, chromium mordants, organic mordants, tannin materials, soluble oil, fixing agents, leveling agents, assistants, and numerous other compounds, not dyestuffs, that are extensively used in the textile industry.

Under this heading are included the definitions of various terms and classes of compounds used by textile colorists, such as color lakes, pigments, fixing agents, developing agents, mordanting assistants, mordanting principles and leveling agents.

Theory of Dyeing. — A discussion of the chemical, mechanical, solution and absorption theories, and the various views that have been advanced by different investigators of the chemistry and physics of textile coloring processes.

Under this heading are discussed the general methods of classifying dyestuffs and the definitions of such terms as textile coloring, dyeing, textile printing, substantive and adjective dyestuffs, monogenetic and polygenetic dyestuffs.

Natural Organic Coloring Matters. — Properties and application of indigo, logwood, catechu, or cutch, Brazil wood, cochineal, fustic, tumeric, madder, quer-

citron bark, Persian berries, and other natural dyestuffs that have been used within recent years by textile colorists.

Mineral Coloring Matters. — Under this heading are discussed the properties of such inorganic coloring matters and pigments as chrome yellow, orange and green, Prussian blue, manganese brown and iron buff.

Artificial Coloring Matters. — General discussion of their history, nature, source, methods of manufacture, methods of classification and their application to all fibers.

Special study of basic coloring matters, phthalic anhydride colors, including the eosins and phloxines; acid dyestuffs, Janus, direct cotton, sulphur and mordant colors, including the alizarines and other artificial coloring matter requiring metallic mordants; mordant acid and insoluble azo colors, developed on the fiber; reduction vat colors, aniline black and other artificial dyestuffs not coming under the above heads.

As each class of dyestuffs is taken up, the details of the methods of applying them upon all the different classes of fabrics and in all the different forms of dyeing machines are thoroughly discussed; also the difficulties which may arise in their application, and the methods adopted for overcoming them.

Machinery used in Dyeing. — A certain amount of time is devoted to the description of the machinery used in various processes of textile coloring which is supplemented as far as possible by the use of charts, diagrams and lantern slides.

Most of the important types of dyeing machines are installed within the dyehouse of the school, and the students can be taken directly from the lecture room and shown the machines in actual operation. [All courses.]

Dyeing Laboratory — C–22. Preparation: C–21 taken simultaneously. Besides lectures and recitations upon the subject of Textile Chemistry and Dyeing, practical laboratory work is required. By the performance of careful and systematic experiments the student learns the nature of the various dyestuffs and mordants, their coloring properties, their action under various circumstances, and the conditions under which they give the best results. The more representative dyestuffs of each class are applied to cotton, wool and silk, and each student is obliged to enter, in an especially arranged sample book, a specimen of each of his dye trials with full particulars as to the conditions of experiment, percentage of compounds used, time, temperature of dye bath, etc.

For convenience and economy most of the dye trials are made upon small skeins or swatches of the required materials, but from time to time students are required to dye larger quantities in the full-sized dyeing machines which are described elsewhere.

By the use of a small printing machine the principles of calico printing are illustrated, and by means of the full-sized dyeing machines and vats the practical side of the subject is studied. It is the constant endeavor of those in charge to impart information of a theoretical and scientific character that will be of value in the operation of a dyehouse. [Course IV.]

Advanced Inorganic Chemistry — C–23. Preparation: C–10. The whole subject of Inorganic Chemistry is reviewed during the second year, and many advanced topics are introduced which were necessarily omitted from the first-year course in General Chemistry. [Course IV.]

Advanced Organic Chemistry — C–24. Preparation: C–10. In this course, which consists of lectures and recitations, the principles of organic substitution and synthesis are thoroughly discussed, and as many illustrations are used as time will permit, particularly such as are applied in the arts. The aliphatic series of hydrocarbons and their derivatives are studied for about twenty weeks, the remainder of the time being devoted to the benzine series. The aim of the course is to lay a broad foundation for the study of the chemistry of the artificial dyestuffs. Students are required to work out problems in the synthesis of various compounds, in order to become familiarized with equation writing. [Course IV.]

Quantitative Analysis — C–25. Preparation: C–12, C–13. The object of this course is to teach the fundamental principles of quantitative analysis, and to give the student an opportunity of acquiring skill in manipulating the special apparatus used in analytical procedure.

Typical gravimetric methods are taught the first term. The samples analyzed comprise salts, minerals and ores. Electro-chemical analysis is carried out with the aid of a modern type of apparatus designed for rapid work.

The work of the second term consists of volumetric methods. A number of ores and commercial products, carefully chosen, are analyzed so as to give the student a varied experience.

The laboratory work is supplemented by lectures and recitations. Smith's "Quantitative Chemical Analysis" is used as a text. [Course IV.]

Quantitative Analysis — C–30. Preparation: C–25. The fundamental principles acquired in course C–25 are applied in this course in the examination of materials used in the textile mill, the dye house, and the finishing plant. Among the materials analyzed are water, soaps, oils, textile fabrics, stripping agents, acids and alkalies. The latest and most practical methods are employed. Griffin's "Methods of Technical Analysis" is used as a text. [Course IV.]

Industrial Chemistry (Lecture) — C–31. Preparation: C–23, C–24. During the whole of the third year lectures and recitations are held in industrial chemistry, the course in general following Rogers' "Manual of Industrial Chemistry." Particular attention is paid to those subjects which are of special interest to the textile chemist, as oils, soaps, gas and coal-tar industry, building materials, and the manufacture on a large scale of important chemical compounds, such as the common acids and alkalies, bleaching powders, various mordants, etc. The course is illustrated as far as possible with specimens, diagrams and charts, and the students are given an opportunity to visit some of the industrial establishments in the vicinity of Lowell and Boston. [Course IV.]

Advanced Textile Chemistry and Dyeing — C–32. Preparation: C–21, C–22. This is a continuation of the Textile Chemistry and Dyeing Course of the second year, and includes a review of the second year's work in this subject, with the introduction of many advanced considerations, and, in addition, the following subjects: —

Classification and Construction of Artificial Dyestuffs. — A study from a more advanced standpoint of the classification and constitution of artificial dyestuffs including the various methods used in their production, also the orientation of the various groups which are characteristic of these compounds, and their effect on the tinctorial power of dyestuffs.

The object of this study is to give the student a more complete knowledge of the artificial dyestuffs from the color manufacturer's point of view, which will prove of particular value to those who intend later to enter the employ of dyestuff manufacturers or dealers.

Color Matching and Color Combining. — A study of that portion of physics which deals with color and the many color phenomena of interest to the textile colorist. The lecture work is supplemented with the practical application of the spectroscope and tintometer, and much practice in the matching of dyed samples of textile material.

The primary colors both of the scientist and textile colorist, the results of combining coloring lights and pigments, and such subjects as color perception, color contrast, purity of color, luminosity, hue, color blindness, dichroism, fluorescence and the effect of different kinds upon dyed fabrics, are discussed under this heading.

Each student's eyes are tested for color blindness early in the course, in order that he may be given an opportunity to change his course if his eyes should prove defective enough to interfere with his work as a textile colorist.

A dark room has been provided where various experiments in color work and color matching may be performed.

Dye Testing. — This subject includes the testing of several dyestuffs of each class, subjecting them to the common, color-destroying agencies; the determining of their characteristic properties, and their action towards the different fibers; also the determining of the actual money value and coloring power of dyestuffs in terms of a known standard.

Each student is required to make a record of each color tested upon an especially prepared card, which furnishes a permanent record of all dyestuffs, their dyeing properties, fastness to light and weather, washing, soaping, fulling, perspiration, bleaching, steaming, ironing, rubbing, acids and alkalies.

Union Dyeing. — A study of the principles involved in the dyeing of cotton and wool, cotton and silk, and silk and wool union materials in the production of solid and two-color effects.

Textile Printing. — A thorough study of the whole subject of textile printing, each student being required to produce individually no less than twenty different prints, including the following styles; pigment style, direct printing style, steam style with tannin mordant, steam style with metallic mordant, madder or dyed style, the ingrain or developed azo style, discharge dye style, discharge mordanted style, resist style, indigo printing, aniline black printing.

The different parts of the calico printing machine are thoroughly studied; also the precautions which must be considered in its use, and the arrangement of the dyeing apparatus which must accompany such a machine.

Special attention is paid to the methods of mixing and preparing the various color printing pastes that are used in the above work upon a manufacturing scale as well as experimentally in the laboratory.

Cotton Finishing. — A study of the various processes of finishing cotton cloth and the different materials used therein. The work involves the discussion of the various objects of cotton finishing and such operations as pasting, damping, calendering, stretching, stiffening, mercerizing, beetling and filling, and the various machines used for carrying out these processes.

Mill Visits. — During the third and fourth years visits are made to some of the large dyehouses, bleacheries and printworks in the vicinity. [Course IV.]

Physical Chemistry — C–33. Preparation: C–23, C–24, B–22. Two hours of lectures and recitations per week are given during the second term of the third year and throughout the fourth year. This subject includes a study of the fundamental laws and theories of chemistry, and the application of physical measurements to chemistry with illustrative problems. Special attention is given to textile applications. [Course IV.]

Organic Chemistry Laboratory — C–34. Preparation: C–21, C–23, C–24, C–25. This course, while including practice in the usual methods of organic analysis, and giving excellent training in the principles and manipulations of general organic synthesis, is especially devoted to the synthetic dyestuffs. The student not only prepares many of the representative dyestuffs, but, what is far more important, he carries out all the operations, beginning with coal tar itself. Thus, instead of merely coupling two or more of the foreign imported intermediate products to make a dyestuff, he starts with the basic substances obtained from the coal tar, and makes his own intermediate products. As far as is possible the student will be made acquainted with the problems which might arise in a dyestuff factory, and an excellent opportunity is presented for original work. [Course IV.]

Technical German — C–35. Preparation: E–21, C–21, C–23, C–24. This course consists of the reading of German technical literature, with the object of familiarizing the student with the current German publications in textile chemistry and coloring. [Course IV.]

Advanced Organic Chemistry — C–36. Preparation: C–24. This is a continuation of Advanced Organic Chemistry C–24. [Course IV.]

Technical German — C–40. Preparation: C–35. This is a continuation of Technical German C–35. [Course IV.]

Organic Chemistry Laboratory — C–41. Preparation: C–34. This is a continuation of Organic Chemistry Laboratory C–34. [Course IV.]

Engineering Chemistry — C–42. Preparation: C–23, C–24, C–25. A series of lectures is given upon the general subject of Engineering Chemistry, which includes particularly the consideration of fuels, oils and water from the chemical engineer's standpoint. The elements of chemical engineering are also considered to such an extent as time will permit. [Course IV.]

Industrial Analysis — C–43. Preparation: C–25. The lectures in Engineering Chemistry are very adequately supplemented by work in the Industrial Analysis Laboratory, which is thoroughly equipped with the latest and best apparatus for the testing of fuels, flue gases, and lubricating materials. [Course IV.]

Physical Chemistry — C–44. Preparation: C–33. This is a continuation of Physical Chemistry C–33. [Course IV.]

Advanced Textile Chemistry and Dyeing — C–45. Preparation: C–32. This is a continuation of the third year work in Advanced Textile Chemistry and Dyeing, and includes the following subjects: —

Advanced Organic Chemistry (Dyestuffs). Advanced study of the coal-tar coloring matters, their chemistry, relations of their composition to their coloring power, and the chemistry of their preparation.

Economics of the Dyeing, Bleaching and Finishing Industries. — A study of the factors to be considered in the establishment of a dyeing, bleaching and finishing plant together with the most essential considerations of its management.

Advanced Dyeing Conference. — During the latter part of his course each student will be required to write, for presentation before the other members of his class, a paper upon some assigned subject of general interest. After presentation the subject will be open to discussion and question.

The object of this conference is twofold. First, to give the student experience and practice in systematically looking up an assigned subject, and presenting it before others; and secondly, to bring before the class a greater variety of subjects with more detail than could be covered by the general lectures of the course. [Course IV.]

Microscopy and Photomicroscopy — C–46. Preparation: B–22, C–21, C–23, C–24, C–25. The value of the microscope in a great variety of analytical and industrial applications related to the manufacture, processing and examination of fibrous materials cannot be overestimated. Often facts or conditions may be discovered by its use which could be arrived at in no other way.

In this course the students become acquainted with the broad field of usefulness of the microscope in physical and chemical industrial microscopy and receive instruction in the theory and use of microscopes with their common accessories, and in industrial microscopic technique. In the the laboratory the students do as much work with the instruments and accessories and in the solution of practical and typical problems as time will permit.

In conjunction with the course on microscopy and leading up to photomicrography, the students are given an excellent ground work in photography in which, by lecture and laboratory work, all of the common photographic processes are explained and performed.

With this preliminary training in microscopy and photography the students are then introduced to the difficult art of photomicrography and do as much work therein as time will allow. Both the microscopical laboratory and the photomicrographic laboratory are well equipped. [Course IV.]

Quantitative Analysis — C–47. Preparation: C–30. This course consists of lectures, recitations and quizzes on the theory of analytical procedure, and the sampling of materials. [Course IV.]

Thesis — C–48. Before graduation the student must present a thesis which shall consist of a report of some original investigation or research that he has conducted while at the school.

A relatively large number of hours are specially set aside for this work, and students are encouraged to select some object for their investigation which shall be of practical as well as theoretical interest. [Course IV.]

TEXTILE DESIGN AND WEAVING DEPARTMENT — D

Textile Design and Cloth Analysis — D–10. During the first year instruction is given in the subject of classification of fabrics, use of point or design paper, plain fabrics, intersection, twills and their derivation, sateen, basket and rib weaves, checks and stripes, fancy weaves, including figured and colored effects; producing chain and draw from design, and *vice versa;* extending and extracting weaves.

This subject takes up in a systematic manner the analysis of samples illustrating the various cloth constructions for the purpose of determining the design of the weave and the amount and kind of yarns used, and forms the basis of calculation in the cost of reproducing any style of goods. The various topics discussed are reeds and setts; relation and determination of counts of cotton, woolen, worsted, silk and yarns made from the great variety of vegetable fibers; grading of yarns, folded, ply, novelty and fancy yarns; application of the metric system to yarn calculation;

problems involving take-up, average counts, determination of counts of yarn, and weight of yarn required to produce a given fabric. [First term, all courses.] [Second term, Courses, I, II, III, VI.]

Textile Design and Cloth Analysis — D–20. For Cotton Goods — Preparation: D–10. During the second year consideration is given to fancy and reverse twills, diaper work, damasks, skip weaves, sateen fabrics with plain ground, backed fabrics, and multiple ply fabrics. Students are required to make original designs and put the same into the loom. Special attention is given to the consideration of color effect.

During the first term free hand drawing is taught by means of plates, and practice in coloring is given in conjunction with this work.

Practice, in lettering, spacing and general arrangement of designs and sketches is given. The engineering alphabet is used in all work.

During the second term instruction is given in drawing, sketching, coloring and designing, with reference to their application in textiles. Good examples of applied design in textiles, as well as in other branches, are used as a basis for modified designs selected and composed by the student. This stimulates originality as well as teaches the student to appreciate good designs and color.

The analysis of these fabrics forms a part of the course in design. This also includes the necessary calculations required to reproduce the fabric or to construct fabrics of similar character. [Courses I, III, VI.]

Textile Design and Cloth Analysis — D–21. For Woolen and Worsted Goods — Preparation: D–10. During the second year the instruction given includes warp and filling backed cloth, figured effects produced by extra warp and filling, double cloths multiple ply fabrics, cotton warps, blankets, bath robes, crêpes, filling reversible, Bedford cords, imitation furs, crépons, matelasse and imitations, double plain, ingrains, velvets, corduroys, overcoatings, trouserings.

The analysis of these fabrics, together with the consideration of the shrinkages and dead loss in all fabrics, theory of diameter of yarns, and costs of mixer blends, is a part of this course. [Courses II, III, VI.]

Textile Design and Cloth Construction — D–30. Preparation: D–20 or D–21. The advanced work takes up the more complicated weaves adapted to harness work, and leads into leno and Jacquard designs. The following is a brief list of the subject heads, which will give some idea of the course: double plain cloths, ingrains, tricots, chinchilla, tapestry, blankets, upholsteries, spot weaves, pile or plush, crêpon, matelasse and its imitations, piqué, Marseilles, quilting, and miscellaneous designs for Jacquard, leno, fustian, tissue fabrics and lappets.

Original designs and sketches for particular grades of goods and the study of color effects form an important part of the third-year course. It should be understood that work in decorative art is carried on in conjunction with textile construction and weaving, particularly on the Jacquard loom. Designs of merit are carefully developed in detail and woven into cloth.

The work in cloth construction includes the application of the different weaves and their combinations in the productions of fancy designs, both modified and original; the calculation involved in the reproduction of standard fabrics changed to meet varying conditions of weight, stock, counts of yarn and value; and the discussion of the breaking strength of fabrics and relationship of the construction of the fabric to breaking strength.

Instruction in this subject, which is given by classroom work is intended to bring together the principles considered under the subject of design, cloth construction, weaving and yarn making of previous years, and to show the bearing each has in the successful construction of a fabric. [Courses III, VI.]

Decorative Art for Special Students. — This course is planned to give a student a working knowledge and appreciation of design. The first and second years are devoted to a general study of design, color, perspective, lettering and rendering. Drawings are made in the historic styles for all materials, — wood, gold, silver, copper, brass, leather, fabrics, wall papers and glass.

In the third year students should specialize and devote their attention to the material in which they expect to work.

Power Weaving — D–22. Preparation: D–10. In connection with the work in Textile Design and Cloth Analysis practical work is carried on upon the power

looms. This includes the preparation of warps, beaming, dressing, sizing, drawing-in and making of chains, the cutting and lacing of cards, spooling and quilling and the machinery for the same. A study is made of warpers and sizing machines, both for cotton and woolen. Lectures are given to correspond with the progress of the student in the Power Weaving Laboratory covering the following subjects: loom adjustments, chain building, shuttle changing looms, dobby looms, single and double acting dobbies, handkerchief motions, leno weaving, center selvedge motion, filling changing looms, oscillating reeds, lappet motions, various shaker motions, towel and other pile cloth weaving, Jacquard looms, single and double lift leno Jacquards, Jacquards of special design, tying up Jacquard harness. [Courses I, II, III, VI.]

Power Weaving — D-31. Preparation: D-20, D-21, or D-22. Instruction is given in weaving on fancy woolen and worsted looms, single and double acting dobbies, leno weaving, various shaker motions, lapper loom weaving, double and single lift Jacquard looms, tying up Jacquard harness, leno Jacquard, harness and box chain building; warp preparation for woolen and worsted and cotton; formulas for making up different kinds of sizing. Lectures are given to correspond with the same. [Courses, I, II, III, VI.]

LANGUAGE AND HISTORY DEPARTMENT — E

English — E-10. Preparation: Admission Requirements. A technically trained man should be able to express himself clearly, forcibly and fluently, as inability to do so will be a serious handicap to him in after life. The object of the English course is to develop the student's power of expression by a thorough study of the principles of advanced rhetoric and composition, and by constant writing of themes illustrative of the four forms of discourse, viz., description, narration, exposition and argumentation. In addition to the study of rhetoric and composition and the writing of themes, several classics such as are not read in the preparatory schools are studied and discussed. [All courses.]

Elementary German — E-11. Preparation: Admission Requirements. This course is intended for first-year students who do not offer German as an entrance requirement and who desire to take the course in Chemistry and Textile Coloring. It may be selected by students taking the Textile Engineering course who have not fully met the entrance requirements in language. The work is elementary in character, and much time is devoted to the study of the rudiments of German grammar with practice in composition. During the latter part of the year considerable attention is given to the reading of ordinary German prose, which serves as an additional preparation to the student for the later reading of works along scientific and industrial lines.

Elementary French — E-12. Preparation: Entrance Requirements. This course is intended for first-year students, who elect the Textile Engineering course and who have had two years' work in this subject. Facility in translation is acquired by a considerable amount of reading from general or scientific sources.

Advanced French — E-20. Preparation: E-12. For students who are pursuing the Textile Engineering course and offer two years' preparatory school work in French, a course in translation of scientific French is required during the second year. [Course VI.]

Advanced German — E-21. Preparation: E-11. For students who are pursuing a degree course the elementary course of the first year is continued throughout the second year. The work consists of the study of some of the more advanced principles of grammar, and especially of the reading of scientific German dealing with a variety of subjects, and the translation of commercial German. [Courses IV, VI.]

Industrial History — E-22. Preparation: Admission Requirements. The economic history of a nation is not less interesting or dramatic than its political history, while it is absolutely essential to a thorough understanding of modern business conditions. The object of this course, which is intended for second-year students, is to trace the development of the three leading industrial nations of the world, viz., the United States, England and Germany, from simple, isolated agricultural communities to the complex, industrial and commercial society of to-day. The course consists of weekly lectures supplemented by textbook reading. Among

the topics treated are natural resources; colonization, territorial expansion; manufactures; agriculture; finance; commerce; transportation; revenue tariffs; monopolies; governmental regulation; organization of labor; industrial legislation; immigration; conservation; contemporary problems. During the year each student will be required to write two or more theses on subjects connected with industrial history, in order that he may have practice in research work and also may continue his training in English. [All courses.]

Economics — E-30. Preparation: E-10, E-22. This course consists of lectures supplemented by recitations based upon both the lectures and a textbook. The character of the course is descriptive rather than theoretical, and the aim is to acquaint the student with the accepted principles of economics and some of their applications to industrial conditions.

Among the topics discussed are the nature and scope of economics; the evolution of economic society; the three factors of production, land, labor and capital; the four elements in distribution, rent, wages, interest and profits; business organization; value and price; monopoly; money, credit and banking; international trade; protection and free trade; transportation; insurance; economic activities of municipalities; and public finance. In short, the course deals with the fundamental principles that underlie a wide range of activities. [Courses IV, VI.]

COTTON DEPARTMENT — F

Cotton Technology of Fibers — F-10. This general course of lectures, given during the second term of the first year, covers in a broad way the manufacture of cotton into yarns. The instruction covers the classification, grading and stapling of cotton, a study of the mechanical operations in yarn manufacture, a consideration of the product and waste of each of the operations, and the uses for which various yarns are suited. [All courses.]

Yarn Manufacture — F-20. Preparation: B-10, B-12, B-14. Instruction is given by means of lecture and laboratory work. The outline of the course is as follows: —

Fiber. — Before taking up the details of the operation of manipulating the fiber into yarn, a careful study is made of the characteristics and classification both botanically and commercially, of the many varieties of the cotton fiber. Methods employed in cultivating, marketing, grading and stapling are considered, and under these heads a detailed study is made of the types of gin employed.

Opening and Picking. — Instruction in the preliminary operation of opening and picking covers the mechanical construction of the machines, their parts and adjustments, as fully as the manufacturing results accomplished by the machines. This includes such construction details as evener, lap measuring and safety stop motion, grids, cleaning trunks, beaters, etc.; also operation details which involve the adjustment of waste, drafts and character of laps.

Carding. — The process of carding is considered one of the most important, and proper time is devoted to the construction and operation of cards that the student may be familiar with the various parts of the card and the function and design of each. The construction and application of card clothing, as well as the methods of grinding, form a part of the work.

Combing. — This process is explained by lecture work and by operation and assembling of the various types of combs in service in the laboratory. The object of combing is fully considered, and the different means employed on the many types of combers on the market is studied. This includes such types as the Heilman, New Whitin and Nasmith combers.

Drawing. — Under this head is taken up the theory of doublings and their effect upon the quality of roving and yarn. Like previous and subsequent processes the machine construction forms an important part of the work. Proper stress is paid to such subjects as stop motions, drawing rolls and their covering, cleaners and evener motions.

Roving Processes. — Under this head are studied the various machines known as the slubber, intermediate, fine and jack fly frames. The relative motion of the various parts of these machines is so complex that a good opportunity is here presented to fix in the student's mind the application of certain mechanical principles that are used in other departments and upon other machines in the manu-

facture of textile material. With each process of yarn manufacture are explained the systems of sizing and numbering, and under this head are taken up both the metric and English systems. [Course I.]

Yarn Manufacturing — F–20a. Preparation: B–10, B–12, B–14. This course is similar to course F–20, except that there is much less time devoted to laboratory work. [Courses III, VI.]

Yarn Manufacture — F–30. Preparation: F–20. Ring Spinning and Twisting — The consideration of spinning yarn by the ring frame method involves a knowledge of the uses to which the yarn is to be put, subsequent methods of handling that proper roving may be selected, suitable amounts of draft and twist provided, correct size of rings and travelers selected, building motions suitably adjusted, etc. The operation of twisting yarns is so closely related to spinning by the ring method that it is studied at the same time. This opens an almost limitless field of novelty yarn manufacture, and offers a very good opportunity to derive new types of yarn or new mechanism to produce the effects. Yarn defects are studied with reference to the cause and remedy.

Mule Spinning. — This method of spinning is very different from that of the ring frame, and the mechanical details are more complicated. The student is furnished with new means of producing yarns, and can compare the relative advantage of each method. A thorough understanding of mule spinning is perhaps more a study of mechanical motions and their functions. This results almost invariably in assisting the student to understand previous processes and machines better because of his work on the mule. It is the object to make clear to the student's mind the principles underlying the construction and operation of the parts that control the drawing, twisting, backing off, winding, together with such special motions and devices as are used upon the modern mule.

Spooling. — This subject involves a study of the various types of spoolers, spooler speeds, tensions and production.

Winding. — The different makes of winders, the packages they make, the peculiarities, special features and production of each are discussed in this work.

Reeling. — Under this topic is included the construction of the machine, the types of winding possible, the quantity of yarn in a skein, and the packing of skeins into bundles. [Course I.]

Yarn Manufacturing — F–30a. Preparation: F–20a. This course is similar to Course F–30 except that there is much less time devoted to laboratory work. [Courses III, VI.]

Knitting — F–31. Preparation: B–12, D–10. This course, commencing with a study of hosiery yarns and their preparation for knitting, includes a study of the various stitches and their application in commercial fabrics; a study of the different knitting machines, including circular and flat spring and latch needle machines used in the manufacture of stockings, sweaters and underwear; and a study of looping and sewing machines. Part of the work consists of the assembling and adjusting of different types of knitting machines.

In addition, considerable time is spent in the analysis of knitted fabrics. [Courses I, II.]

Knitting — F–31a. Preparation: B–12, D–10. This course embraces the same lectures as Course F–31 but does not include any laboratory work. [Courses III, VI.]

Cotton Organization — F–40. Preparation: F–30. Following the detailed study of the individual processes it is necessary to consider the relation of each to the other, the programs, balance of production, cost of machinery for various counts, quantities and styles of yarns. Under this heading are also studied such subjects as depreciation of machinery, cost systems, economics, arrangement of machinery, power demands, etc. [Courses I, VI.]

WOOL DEPARTMENT — G

Technology of Fibers — G–10. The principles of converting loose fibrous materials into continuous twisted strands called yarn are discussed, and the nature and uses of spindle drawn and roller drawn yarns explained. Particular attention is given to the nature and processing of wool, allied fibers and reworked fibers. The source of supply, original and clean cost, and the effect of tariff and exchange on

fibers and processed materials from foreign countries, illustrated by examples. [All courses.]

Top Manufacture — G–20. Preparation: B–10, B–12, B–14. Raw Materials. — A study of raw materials which enter into the manufacture of woolen or worsted yarns, or are made into yarns by processes similar to those employed in the manufacture of woolen and worsted yarns, would include silk, mohair, alpaca, vicuna, cashmere, camel's hair, cotton, flax, hemp, jute and ramie. In connection with these are considered shoddy, noils, mungo and extracts.

Wool Sorting. — Familiarity with the various grades and kinds of wool is obtained by lecture and by actual sorting of fleece wool under the direction of an experienced wool sorter. The various characteristics and properties are explained, as are also trade terms, such as picklock, XXX, XX, ½-blood, ⅜-blood, ¼-blood, delaine, braid, etc. Some skill is acquired in the estimation of shrinkage and in judging the spinning qualities.

Wool Scouring. — The object of scouring and the methods employed are explained, and this involves the consideration of the soaps and chemicals used in washing; also the waste products and their utilization. Actual work is done in scouring a commercial quantity of wool by machines that are made similar in operation to regular commercial machines. A study is made of the effect of the hardness of water upon soap; also tests are made to show this effect. At the same time the use of dryers, their operation and regulation, is taken up, and the methods of carbonizing wool, noils, burr waste, rags, etc., are studied and practiced.

Burr Picking, Mixing and Oiling. — In these processes, preliminary to carding, the students have an opportunity of mixing various colors of wools to produce different effects, and the influence of varying percentages of a given color in a mixture can be seen. Each student is required to make at least twenty sample mixes combining different colors and grades of stock, and to felt and mount the same. Under the subject of oils and emulsions are taken up the characteristics of various oils and the means employed to test these. The use of mixing and burr pickers is made clear.

Carding. — The different systems of carding wool, depending upon whether it is to be made into woolen or worsted yarn, are fully explained, as is also the construction, setting and operation of the cards. A part of the work is the reclothing and grinding of the cylinders, strippers, workers, etc. The carding of suitable and commercial quantities of wool, and the further manufacture of it into yarn, serves to fix the principles of carding in the mind of the student, as well as to give him some skill in handling machinery. At the completion of this part of the work he is required to prepare and hand in a full description of the process of carding, including working drawings, sketches, etc., to fully explain the machines and the methods.

Woolen Mule. — The student studies thoroughly the operation of the mule as a whole, and acquaints himself with the various principal mechanisms, as, for example, the backing off and winding motions, the quadrant, builder-rail, faller regulation, etc.

Top Making and Combing. — This branch takes up, besides the carding of the wool on a worsted card, the preparing processes, back-washing and Vigoureaux printing, also gilling of the stock before and after combing. The construction of the gill boxes and combs is studied by lectures, and by dismantling and assembling these machines in the laboratories. Later, quantities of stock are made into top and then into yarn.

The Noble comb is studied, and the various calculations to determine draft, noiling, tear, productions, etc., are made. [Courses II, III, VI.]

Yarn Manufacture — G–30. Preparation: G–20. Intersecting Gill Boxes and French Comb. — The equipment of the laboratory offers opportunity for the production of dry combed top and its comparison with oil combed top produced on the Noble comb. The structures and uses of intersecting gill boxes and the study of combing and drawing blends is taken up at this point.

Drawing and Spinning. — The laboratory equipment consisting of the Bradford (English) system of drawing, of both open and cone types, as well as the various processes of French drawing, followed by both worsted mule and ring spinning

frame, make possible a thorough study of the manufacture of worsted yarn by all of the existing methods.

The same method of study of mechanisms, calculations, and operations of the various machines is followed as in the case of previous methods of instruction. The student by pursuing this course can compare the different methods of yarn manufacture and note the results of each.

Organization. — At the end of the course the layout of a properly balanced yarn mill is studied, and at the same time the cost of machinery, depreciation, labor costs and machinery arrangments.

Thesis. — Before graduation, the student must present visible evidence of his knowledge of woolen and worsted manufacture by the production of twenty yards of fabric from his own design (or reproduction or modification of some existing fabric) beginning with the raw material.

A formal typewritten description, including all calculations and observations, together with samples from each machine, must be presented to the head of the department before the final examination. [Courses II, III, VI.]

Textile Testing — G–31. Preparation: B–22, F–30 or G–30, D–22. The object of this course is to familiarize the student with present-day methods of determining the physical properties of textile fibers, yarns and fabrics. The application of physical laws and methods of measurements, as studied in the Course of Physics, is used in the study of physical characteristics of textile material. The work is given to students in advanced courses, and consists of lecture and laboratory work. Reports are prepared from each experiment, giving the object of the experiment, method of procedure, observation and conclusions, in order that the student may acquire practice and understand the interpretation of data. A special testing laboratory is provided, and a considerable number of the best standard fiber, yarn and fabric testing instruments of foreign and American make have been installed and are used for instruction in the testing of textile materials. The laboratory is equipped with means for making and keeping the humidity constant, so that tests can be made under uniform or standard conditions of humidity and temperature. [All courses.]

FINISHING DEPARTMENT — H

Woolen and Worsted Finishing — H–30. Preparation: B–12, C–10, D–10, D–22. The outline of this course, which is given by means of lecture and laboratory work, is as follows: —

Burling and Mending. — Under this head is taken up for consideration the examination of flannel as it comes from the loom; the construction, use and location of the perch; the methods used in marking defects, measuring, weighing and numbering of cloths; also the methods of inspection for fancies, single cloths and double cloths. The object of burling, mending and the types of tables employed, the method of removing knots, runners, etc., the object of back shearing and the use of burling irons, the replacing of missing threads and the importance of sewing as a part of the finishing process, are all considered in detail. The removal of oil and tar spots as well as stains of various kinds is studied.

Fulling. — This branch covers a study of the conditions of the flannel as it comes from the loom, and the influence of oil, etc., upon the procedure. Considerable time is devoted to the various methods of producing a felt, the early types of stocks, hammer falling and crank stocks, and their modifications and development into the present type of rotary fulling mills of both the single and double variety. The details of construction in all machines are carefully taken up and include the design and composition of the main rolls, methods of covering, regulation and means of adjusting the pressure of traps and rolls, consideration of the shoes, the use and regulation of the various types of stop motion, the different types of stretchers, guide rolls and throat plates.

The theory of felt is taken up and the influence of pressure, moisture, heat, alkali and acid is considered, as well as the hydroscopic and felting properties of different wool fibers. The preparation of the flannel for the mill and the usual methods of determining shrinkages, as well as the various methods of soaping, are given careful attention. The preparation of various fulling soaps and the value of each for the production of various degrees of felt as well as the determination of the proper

Wool Combing

amount of alkali for various goods, are carefully studied and demonstrated. The manipulation of the various kinds of goods in the mill, viz., all wool, shoddies and mixed goods, is studied in classroom and by operation in the mill.

The change in weight and strength for each operation is carefully considered, as is also the value of the flocks made in each. A study of the various methods of flocking, such as dry and wet, is considered in both class and machine rooms. In each operation the defects likely to materialize are studied, as well as the cause thereof, and various methods of modifying or lessening them.

Washing and Speck Dyeing. — This branch considers the scouring, rinsing and washing of goods both before and after the fulling process; the various types of washers; and the details of construction, such as suds box, rolls, etc. The theory of scouring, uses of Fuller's earth, salt solutions and scours on the different kinds of goods are made clear by practical work in the machine room, where the effects due to improper scouring, such as stains, cloudy effects, wrinkles and unclean goods, are demonstrated. The discussion of the necessity of speck dyeing follows naturally from the study of these matters, and includes methods of preparation, materials used, application and tests required.

Carbonizing. — This is an important branch of finishing, and includes a study of the various carbonizing agents, methods of application, strength of solutions, and neutralizing, as well as the machines used. Stains and imperfections resulting from carbonizing are also considered. The drying and tentering machines and extractors employed are taken up at this point.

Gigging, Napping, Steaming, Singeing and Crabbing. — The construction in detail of the various types of gigs, nappers, steamers, wet gigs, rolling, stretching, crabbing and singeing machines is discussed, and their actions upon the cloth and the results obtained are explained.

Various methods of obtaining luster and the production of permanent finish are considered in connection with steaming and sponging.

Brushing, Shearing and Pressing. — This includes, as do the other branches, a careful treatment of the machine employed, the preparation of the cloth for each process, the action of each machine in producing its part of the resultant effect. In manipulation of the shear consideration is given to its setting, grinding and adjustment. With the brushing machine the effect of steaming and moisture upon the luster and feel of the goods is shown. A study of the action of the presses, both plate and rotary, involves consideration of pressure, steaming, etc. Special processes to obtain particular effects are taken up, and the part played by each machine is explained. The details involved in handling cloth on a commercial scale, as, for example, measuring, weighing, ticketing, numbering and rolling, are also explained. The necessary calculation and the methods of finishing all grades of goods are considered from time to time during the year. [Courses II, III, IV, VI.]

Cotton Finishing — H-31. Preparation: B-12, C-10, D-10, D-22. The outline of the course in the finishing of cotton fabrics is as follows: —

Cloth Room. — Instruction of the various goods and the object thereof; construction of the various types of inspecting and trimming machines.

Shearing. — The object. A consideration of the various types of shears for treating one or both sides at the same time; also the use of the usual cleaning devices, such as emery, sand and card rolls, beaters and brushes; grinding and the adjustment of the various parts.

The use of brushing and cleaning machines, rolling devices and calender attachments for gray goods.

Singeing. — Developing and object of singeing; the construction of singers of all types, and for various purposes; the use of cooling tanks, steaming devices, rolling and brushing attachments.

Regulation of the flame for various goods, and adjustment of the parts; gas and air pressure, water-cooled rolls; the effect of moisture on the cost of singeing and use of dry cans in connection with singeing; electric singeing.

Washing. — Open width and string washers, their construction and operation: soaps, temperature, squeeze rolls; washing of various goods and the object thereof; stains.

Napping. — The object of napping and the usual method of treating goods;

various types of nappers, single and double acting; felting nappers; construction, grinding and adjustments of various types.

Water Mangles. — Their objects and the construction of various types; various rolls, iron, husk, etc.; scutchers, their object and constructions.

Starch Mangles. — The object and construction of all types of starch mangles for pure starch and filled goods; various types of rolls, brass, rubber, wood; action of doctor blades, etc.; regulation and object of pressure.

Methods of starching and finishing all standard goods, also a consideration of the various substances used, such as starch, softener and fillers; the preparation of starch and various methods of application.

Dryers and Stretchers. — Both horizontal and vertical types of drying cans, tenter frames, clips, etc.; the swing motion and the finishes thus produced; object and construction of spraying machines, belt stretchers, short tenters, button breakers, etc.

Calenders. — The object and construction of all types, including the regulation of pressure and nips for the production of various finishes; various types of rolls and their uses, — steel, husk, cotton, paper, etc.; the use of hot and cold rolls; chasing, friction, embossing and schreiner calenders, and the various finishes produced by each; production of watered effects; beetling machines and hydraulic mangles.

Making up room, — yarding, inspecting; different types of folds; pressing, papering, marking. [Courses I, III, VI.]

PHYSICAL EDUCATION

All members of the freshman class are required to take a course in physical training conducted in the gymnasium under the direction of an instructor in physical education. Two periods per week for the entire first year are devoted to this work. At the beginning of the year a full record is made of the physical examinations carried on by the instructor and a reputable physician that proper and beneficial exercise may be prescribed.

The object is to give general instruction in the care and strengthening of the body, and to so guide the students that they may continue to give proper thought to their physical training that their mental development may have its greatest effect.

Proper gymnasium clothing is required and all students must take a shower bath following each exercise.

EQUIPMENT

The equipment of machinery, inventoried at $330,850.00, is most varied for textile educational purposes, and is being constantly augmented. The builders of the various machines installed keep in close touch with the school, adding to the machines such improvements as are made from time to time, and each year some new machine will be added by a manufacturer who finds it to his advantage to be represented here. This operates to the mutual advantage of student and manufacturer.

Cotton Yarns Department. — The opening and picking section of this department contains a 40-inch two beater breaker lapper with automatic feeder, a 40-inch single beater intermediate and finisher lapper with Perham & Davis sectional plate evener, apron to double four laps, with an extra Kirschner patent carding beater, roving waste opener and a thread extractor, all of which have been installed by the Kitson plant of the Saco-Lowell Shops at Lowell.

There is a 50-saw gin from the Daniel Pratt Gin Company of Prattville, Alabama, besides facilities for teaching the grading and classification of cotton.

The carding, combing and drawing section contains the following machinery from the Saco-Lowell Shops: — a top flat card, three revolving flat cards, two of which form a unit for waste carding, three railway heads and two drawing frames. One of these cards is equipped by the Chapman Electric Neutralizer Co., Portland, Maine, with an electric neutralizer to prevent troubles from static electricity.

The Whitin Machine Works, Whitinsville, Mass., have installed a 40-inch revolving flat card, a sliver lapper, one four-head and a six-head ribbon lapper besides a two-head, a six-head and an eight-head comber.

The H. & B. American Machine Works of Pawtucket, R. I., are represented by the following pieces of machinery: — one 40-inch revolving flat card, one two-delivery drawing frame, a roving frame, spinning frame and ring twister.

The Foster Machine Company of Westfield, Mass., has provided two winders for making cones and multiple wound tubes.

There is a two-head comber with a model comber head made by John Hetherington & Sons, Ltd., Manchester, England.

The roving, spinning, and twisting section has the following machinery installed by the Saco-Lowell Shops of Lowell: — two slubbers one of which is for waste spinning, an intermediate, a fine and a Jack frame, also five ring spinning frames, a spinning mule, spooler and a wet and dry twister.

The Fales & Jenks, Pawtucket, R. I., and the Draper Corporation of Hopedale, Mass., have each provided a wet and dry twister; the Whitin Machine Works, three spinning frames, the Woonsocket Machine and Press Company, Woonsocket, R. I., an intermediate fly frame, and the Asa Lees Company, Oldham, England, through their agents, Wm. Firth Company, a fine spinning mule.

Knitting Section. — The winders for this section include a six-spindle Universal winder for cones and tubes and a Payne bobbin winder.

The machines in the following group are equipped with special attachments for producing lace front work, high splicing, double soling and striped work. The hosiery machines include two Acme full automatic, one arranged for 160 needles and the other for 200 needles; also a Mayo Model C full automatic arranged for 220 needles. Scott and Williams have placed in this section four of their machines, Models B–5, KHH and R I. There are three Banner machines, all full automatic, two of which are arranged for 220 needles each and one arranged for 200 needles. There is one Brinton full automatic arranged for 176 needles and one Branson hand machine arranged for 80 needles. For hosiery legs and tops there are 5 ribbers, made by the Wildman Company, with cylinders varying from 3½–5¼ and arranged for needles varying in number from 160–240; 2 Brinton ribbers, one arranged for 176 needles and the other 200 needles; 1 Brinton tie machine, 1¾-inch cylinder 100 needles and 49 needles.

The underwear machinery consists of one Crane spring needle machine, one Scott & Williams ribber, and one Wildman ribber.

Under the group of flat machines there are three Lamb machines, one arranged for knitting gloves and one arranged for knitting sweaters. In addition to these there is also a Grosser sweater machine, a Jacquard machine, and a link and link machine; a Dubied scarf machine; and a Raschel warp knitter.

For finishing work this section includes a Grosser 2-thread looper, one Hepworth looper, two Beattie loopers; 5 Union special sewing machines for over-seaming, double stitch covering, seaming and welting and vest finishing; 6 Merrow sewing machines, including two shell stitch machines and three over-seaming and crocheting machines; 3 Singer machines; 3 Wilcox and Gibbs sewing machines, including a flat lock machine.

The Philadelphia Metal Drying Form Company has installed a table of six forms including men's, women's and children's.

For instruction in the manufacture of braids the New England Butt Company has installed one 24-line Hercules braider, one 12-line braider, one tubular braider, and one soutache braider.

Wool Yarns Department. — For instruction, in wool sorting and grading the room is provided and equipped with benches, baskets, etc., as well as standard samples of all grades of wool which may be used for comparison and examination.

The scouring and carbonizing equipment installed by C. G. Sargent's Sons Corporation consists of one cone duster for grease wool; four scouring bowls arranged in tandem with necessary feeds and modern carrying properties; one single apron dryer, with automatic feeder; one carbonizing screw acid tank and duster, with crush rolls. In this same department the North Chelmsford Machine Company have supplied a rinse box; Schaum & Uhlinger, one hydro-extractor; C. S. Dodge, one shoddy picker and one bagging stand.

Woolen. — In the woolen section there has been installed by the Atlas Manufacturing Company a Parkhurst Burr picker. The Davis and Furber Machine Company have installed a mixing picker equipped with improved mixing picker

feed and Spencer oiler, both made by George S. Hardwood & Sons, Boston, Mass. There are three sets of woolen cards furnished by Davis and Furber Machine Company which are equipped with Bramwell feed furnished by George S. Hardwood & Son. One of the sets has the first and second breaker cards coupled. All have apron condensers on the finishers. There is a sample mixing card furnished by the Torrance Manufacturing Company which offers an opportunity for carrying on experiments and mixing various kinds and colors of wool. There are two spinning mules, 120 spindles each, one furnished by the Davis & Furber Machine Company of North Andover and equipped with bobbin holders supplied by the American Bobbin Holder Company, West Medway, Mass., and the other furnished by Johnson & Bassett, Worcester, Mass. In addition to these two mules each company has supplied for the purpose of instruction a spinning mule head mounted on movable platform to facilitate class instruction. Besides these mules the Davis & Furber Machine Company have supplied a fancy yarn twister, 20 spindles; the Lindsay Hyde Company modern skein winder. For Card grinding the B. S. Roy and Son Company of Worcester, Mass., have supplied one grinding frame and two traverse grinders; T. C. Entwistle Co., Lowell, Mass., one traverse grinder; W. H. Brown, Worcester, Mass., one complete set of carder's tools.

Worsted. — In the worsted section the Davis & Furber Machine Company have furnished one double-cylinder worsted card (4 licker-in) with Bramwell feed. On this card as well as one in the woolen section the Chapman Electric Neutralizer Company have supplied one of their patented electric neutralizers. This section also includes a double bowl, 5-cylinder back-washer, with gill box, Taylor-Wadworth & Co., Leeds, Eng., equipped with blueing motion, oiling motion, and Layland patent pressure motion; a weigh gill box and creel and one doubling balling head gill box (with double screws) made by the Saco-Lowell Shops of Lowell, Mass.; a worsted comb with baller punch made by Crompton & Knowles, Worcester, Mass.; two finishing gill boxes, one known as a can gill box and the other a balling head gill box, both made by Hall & Stell, Keighley, Eng.

For the manufacture of yarns under the Bradford System of Drawing, Spinning and Twisting the following machinery as made by Prince Smith & Son, Keighley, Eng., make up the equipment: one revolving creel for 12 balls, one 2-spindle drawing box, one 4-spindle first finisher, one 12-spindle dandy reducer, one 12-spindle cap spinner, one double head can gill box, one 2-spindle gill box, one 2-spindle flyer spinner, one 12-spindle ring spinner, one 12-spindle 2-fold cap twister, one 12-spindle 6-fold ring twister. In addition to this the Saco-Lowell Shops, Lowell, Mass., have installed the following machinery to carry on similar work: one 2-spindle drawing box, one 6-spindle second finisher, one 24-spindle dandy rover, one 6-spindle cone reducer, one 8-spindle cove rover, one 48-spindle cap spinner, 5-foot end, one 48-spindle cap spinner, 4-foot end, one 48-spindle Boy ring twister. For conditioning yarn C. G. Sargent's Sons Corporation have supplied one of their conditioning machines. The Universal Winding Company have installed one of their 6-gang winders, equipped for cones or straight tubes.

The humidity in the laboratory of the woolen yarns and of the English system of worsted yarns is maintained by the American Moistening Company's system through their automatic control. In this laboratory are installed six humidifiers and four Comins' High Duty heads, which are supplied from an electric driven triplex power pump located in the power house. This same pumping equipment supplies the American Moistening Company's humidifiers operating in the Cotton Yarn Department.

For the manufacture of worsted yarns under the French System of Drawing and Spinning the machinery has been made by the Societe Alsacienne de Constructions Mechaniques, Mulhouse, France, and the equipment consists of the following: Model P. L. B. comb with creel for 24 doublings, intersecting gill box (2 heads), gill box (2 heads), first drawing (2 heads), second drawing (2 heads), third drawing (2 heads), reducer (4 porcupines), slubber (8 porcupines), first intermediate (8 porcupines), second intermediate (8 porcupines), rover (8 porcupines), finisher (16 porcupines), self-acting worsted mule (150 spindles).

The Saco-Lowell shops have recently built and installed a ring spinning frame of 60 spindles for worsted yarns equipped with individual General Electric Company's motor and a Reeves Variable Speed Transmission.

Twelve turbo humidifier heads automatically controlled by a humidity regulator have been furnished by the G. M. Parks Company, Fitchburg, Mass. The compressed air for these heads is supplied by an Ingersoll-Rand 8 by 8 steam-driven air-compressor.

For the purpose of determining the physical properties of fibers, yarns, and fabrics there has been installed a Textile Testing Laboratory where there are the necessary microscopes and micrometers, a skein testing machine, an electric conditioning oven made by the Emerson Apparatus Company of Boston; single yarn and fabric strength testing machines made by G. R. Smith & Co., Bradford, England; a strength testing machine, capacity 500 kilograms, for testing twines and fabrics; a fiber testing machine for testing fibers and fine yarns with capacity, 1 gram to 1.5 kilograms; a yarn strength testing machine with capacity, 1,000 to 5,000 grams; and a yarn strength testing machine with capacity, 5 to 30 kilograms, all of which have been made by Louis Schopper, Leipzig, Germany. Besides these we have a standard yarn and fabric testing machine as made by Henry L. Scott & Company of Providence, R. I., and a Mullen Tester. For the automatic control of temperature and humidity there has been installed by the American Moistening Company of Boston one of their automatic humidity and temperature regulators.

Design and Power Weaving Department. — In the fabric analysis section there has been provided chemical balances made by Voland & Sons and Christian Becker, necessary twist testers, microscopes, reels, etc., as well as a Torsion calculation balance made by the Torsion Balance Company of New York.

In the warp preparation department there has been installed by the Saco-Lowell Shops one of their spoolers besides a warper and a slasher for preparing cotton warps; a beamer by T. C. Entwistle Company of Lowell, a 400-end improved Draper warper furnished by the Draper Corporation of Hopedale, Mass. The Whitin Machine Company, Whitinsville, Mass., have supplied a 180-spindle, long-chain quiller, and the Johnson & Bassett Company, Worcester, Mass., a quiller of their make. The Universal Winder Company has supplied a winder for copy and bobbin winding and an 8-spindle doubler.

The woolen and worsted warp preparation department contains two 40-end Jack spoolers, two spool racks for 12 spools each, one pattern dry frame dresser, one pipe and cylinder dresser, one 60-inch reel, one 82-inch reel, and one double head beamer, all supplied by the Davis & Furber Machine Company of North Andover, Mass.

The Weaving Department contains four looms supplied by the Draper Corporation of Hopedale, Mass., which include a plain Northrup, an 8-harness corduroy, an improved Northrup, a Northrup with dobby. The Stafford Loom Company of Readville, Mass., has installed one plain, one cam, one dobby loom and one broad sheeting loom, all equipped with individual motors; the Whitin Machine Works, Whitinsville, Mass., a side cam twill, a plain print cloth loom, equipped with Kip-Armstrong electric warp stop motion; the Kilburn and Lincoln a plain loom; Lewiston Machine Company a 4-harness side cam and a bag loom; Crompton and Knowles Loom Works a jean loom and a plain loom with individual drive. Four of these looms are equipped with Abbott cleavers made by the Abbott Wire and Cast Steel Warp Cleaving Company, Lisbon Falls, Me. The Hopedale Manufacturing Company of Milford, Mass., has recently installed one of its high speed looms with individual motor.

The fancy loom section includes a Stafford Ideal 16-harness automatic shuttle-changing loom, a Whitin 20-harness dobby loom and the following furnished by the Crompton-Knowles Loom Works: — Knowles gingham 4 by 1 boxes, Crompton gingham 4 by 1 boxes, one Crompton towel 2 by 1 boxes, two Terry towel and one huck towel looms, a 16-harness lappet loom, a 20-harness dobby 4 by 1 boxes, fancy leno loom, and a Crompton fancy cotton single cylinder 20-harness dobby.

The woolen and worsted section contains a Knowles 20-harness Gem, a Crompton 24-harness worsted 4 by 4 boxes, a Crompton 6 by 1 double cylinder 20-harness dobby, one heavy 20-harness 4 by 4 boxes, one 20-harness and one 25-harness blanket, seven intermediate woolen 25-harness 4 by 4 boxes and two 90-inch 25-harness heavy woolen looms.

The Jacquard loom section includes one Stafford silk loom, 1,200-hook, Halton

head; one 400-hook, single-lift, Schaum & Uhlinger Jacquard, mounted for 4-bank, narrow fabric loom; one Felix Tonnar German plush loom, with 400-hook Crompton & Knowles Jacquard head; one Skinner Brussels carpet loom, three-quarters wide, equipped with 1,280-hook Jacquard head presented by the Bigelow-Hartford Carpet Company, Clinton, Mass. The Crompton & Knowles Loom Works have furnished one Knowles fancy loom, single-lift Jacquard; one Knowles fancy loom, double-lift Jacquard; one Knowles fancy loom, Jacquard tied up for leno, one Knowles ingrain carpet loom, 4 by 4 boxes, one Knowles loom, 4 by 4 boxes, 54-inch, with 600-hook, double-lift, double-cylinder McMurdo Jacquard head, tied up for damask napkin designs, one Crompton ingrain carpet loom, 4 by 4 boxes, one Crompton & Knowles 72-inch tapestry loom, with 2,600-hook Halton Jacquard head, one 840-hook, double-lift, single-cylinder Jacquard on Crompton & Knowles 4-bank ribbon loom, one 800-hook, double-lift Knowles Gem silk brocade Jacquard machine, 4 by 4 boxes.

For the purpose of card cutting there has been furnished one Jacquard fine index card-cutting machine by John Royle & Sons, Paterson, N. J.; one Jacquard French index card-cutting machine by the same concern and one Jacquard French index card-cutting machine, presented by the Bigelow-Hartford Carpet Company, Lowell, Mass.

Chemistry and Dyeing Department. — The Chemistry laboratories consist of one to give instruction in General Chemistry and Qualitative Analysis and provides facilities to take 120 students. The Quantitative Laboratory takes care of some 50 students and contains the necessary drying closet, steam bath, electrolytic table, with ample facilities to provide distilled water through the use of a Barnstead Water Still. The Balance Room, which is adjacent to the laboratory, has eleven analytical balances made by such concerns as Christian Becker, Eimer & Amend, and H. L. Becker's Sons & Co. The Organic Laboratory has facilities to take care of approximately 25 students having the necessary equipment required in the preparation of basis organic compounds and instruments used in the manufacture of dyes such as autoclaves, electric and gas combustion furnaces.

For the purpose of carrying on photographic and microscopic experiments and analyses the laboratory has been provided with equipment which includes besides the Bausch & Lomb microscopes, a polariscope made by Franz Schmidt & Haensch, Berlin, Germany, a Gaestner spectroscope, a Bausch & Lomb Model G photomicrographic apparatus equipped with D. D. S. microscope and all necessary apparatus, a Kodak projection printer. In the dark room there has been placed a piece of apparatus for determining the relative fading powers of various light sources. Besides the common gas and electric lamps there is installed a solar determinator, made by the Atlas Electric Company, Chicago, Ill., also a 400-watt Nela Trutint and color matching unit made by Nela Specialties Division, Cleveland, Ohio.

The Chemical Museum has been provided with cases and representative dyestuffs all furnished by various dyestuff manufacturers of this country and abroad. This offers an unparalled opportunity for students to study and experiment with almost all of the representatives dyes which are used in the textile industry.

The Experimental Dyeing Laboratory is equipped with individual benches, small dyeing apparatus, reels, balances, apparatus for dye testing, such as frames for exposing dyed material to light, and a complete collection of dyestuff samples and sample cards. There are also fifty-six steam coil experimental dyeing baths, a drying chamber and aging chamber, in addition to a Hurricane Dryer, Class D, made by the Philadelphia Drying Machinery Company, Pennsylvania. Adjacent to the Experimental Dyeing Laboratory there has been provided a well-lighted room for the storage of a great variety of dyestuffs. Steel shelving has been arranged so that the samples are easy of access. All samples are catalogued in a card file, thus facilitating their use. In this same room are provided a sink and cement table with balances.

The Experimental Printing Laboratory is equipped with a calico printing machine, made by Mather & Platt, Manchester, Eng., an iron jacketed steaming chamber from A. Edmeston & Son, Patricroft, Eng., and a set of steam jacketed copper kettles.

The Fuel and Oil Analysis Laboratory contains the following equipment for the analysis of coals and fuels: a Mather bomb calorimeter, with complete outfit, an

Emerson bomb calorimeter, with complete outfit, a Parr calorimeter, an Abbe refractometer, a Torsion viscosimeter, a Tagliabue viscosimeter, a Tagliabue cold test apparatus, a Pensky Martin oil tester, a New York State oil tester, a Sartorius specific gravity balance, two Becker analytical balances, gas muffle furnace, Kny-Scherer oil tester, a Graefe gas calorimeter, an Orsat gas analysis apparatus, laboratory tables, lockers, and hoods.

The Industrial Chemistry Laboratory contains the following: one filter press, Type E. T. Shriver & Co., a single-acting triplex plunger pump, Goulds Manufacturing Company, a vacuum drying apparatus, a surface condenser, a Packard vacuum pump, Norman Hubbard's Sons, a vacuum evaporator, Swenson system, American Foundry and Machine Company, a centrifugal, C. H. Chavant & Co., a double jar mill, F. I. Stokes & Co.

For the purpose of carrying on dyeing on a basis which is more comparable with commercial practice there is provided a laboratory which includes the following equipment: a small kier, fitted with E. D. Jefferson's circulating device, an electrolyzer for manufacturing bleaching solutions, the National Laundry Machine Company, Dayton, Ohio, a Permutit filter, the Permutit Company, New York City, a mercerizing machine, a raw stock dyeing machine, Klauder-Weldon Dyeing Machine Company, Yardley, Pa., a yarn dyeing machine, Klauder-Weldon Dyeing Machine Company, a jig dyeing machine, the Textile-Finishing Machine Company, Providence, R. I., a set of drying cans by the same concern, a chain dyeing machine, T. C. Entwistle Company, Lowell, Mass., a raw stock drying table, Proctor & Schwartz, Philadelphia, Pa., a padding mangle, Arlington Machine Works, Arlington, Mass., a hydro-extractor, W. H. Tolhurst & Son, Troy, N. Y., a Psarski experimental dyeing machine, a Hussong experimental dyeing machine, equipped for raw stock or yarns, a Rodney Hunt sample piece dyeing machine, equipped with an automatic temperature and pressure-regulating apparatus, made by C. J. Tagliabue Manufacturing Company, Brooklyn, N. Y. The Franklin Process Company, Providence, R. I., have furnished a 25-pound bronze dyeing machine. Of the various dye tubs, one is equipped with a Monel Metal lining to withstand the action of various chemicals and dyes.

Finishing Department. — The Woolen and Worsted section includes a 4-string washer, a fulling mill, and a combination fulling and washing mill for jersey fabrics, furnished by the Rodney Hunt Company, Orange, Mass.; a sample fulling mill, a kicker mill, furnished by James Hunter & Co., North Adams, Mass.; an up and down dry gig, a rolling and stretching machine, an up and down wet gig, a steam finishing machine, a 60-inch, 3-burner singeing machine, adapted for cotton, silk or worsted goods, a 2-cylinder double-acting brushing machine, a 60-inch, 4-cylinder sanding and polishing machine, furnished by Curtis & Marble, Worcester, Mass.; a 66½-inch motor driven, single woolen shear, equipped with list saving motion, donated by Curtis & Marble Machine Company; a 6/4 double shear, an A. W. C. measuring and weighing machine, furnished by Parks & Woolson, Springfeld, Vt.; a dewing machine, a 6/4 Voelker rotary press, furnished by G. W. Voelker & Co., Woonsocket, R. I.; a single shear, Curtis & Marble, donated by Massachusetts Mohair Plush Company, Lowell, Mass.; a tentering and drying machine furnished by John Heathcote, Providence, R. I., a single crabbing machine, H. W. Butterworth & Son, Philadelphia, Pa.; a 72-inch woolen napper donated by Davis & Furber, North Andover, Mass.; a 32-inch basket hydroextractor, W. H. Colhurst, Troy, N. Y.; a Lintz & Eckhardt cloth numbering machine, improved by Durbrow & Hearne Manufacturing Company, New York; a steam press for underwear, United States Hoffman Company, Syracuse, N. Y.; a sewing machine, Birch Brothers, Somerville, Mass.

The Cotton section includes a 40-inch inspecting and brushing machine, a 44-inch No. 25 railway sewing and rolling machine, a 44-inch cotton shearing machine, Type No. 34, a 44-inch No. 3 steam calender rolling machine, a 40-inch cloth folder, a 40-inch winder and measurer, a set 44-inch shear blades for grinding purposes, furnished by Curtis & Marble, Worcester, Mass.; a 48-inch No. 4 opening, sewing and re-rolling machine, a No. 1 hand power portable railway sewing machine, furnished by Dinsmore Manufacturing Company, Salem, Mass.; a 40-inch 4-tank open soaping machine equipped with patent flushing rolls, brass and rubber squeeze rolls and spiral openers, furnished by Birch Brothers, Somerville, Mass.; an 84-inch 36-roll, ball bearing, double acting napper, equipped with a 7½-horse-

power General Electric motor drive, furnished by Davis & Furber, North Andover, Mass. (the ball bearings were donated by the Fafnir Bearing Company, New Britain, Conn.); an 8-inch belt lacer furnished by the Clipper Belt Lacer Company of Grand Rapids, Mich.; a 40-inch, 3-roll water mangle, with husk and brass rolls and usual attachments and equipped with a 48-inch Mycock scutcher, and a 40-inch Mycock cloth expander made by Thomas Leyland & Co., Boston, a 40-inch, 2-roll starch mangle, a 40-inch upright drying machine with 10 copper cylinders equipped with Files dry can system, Files Engineering Company, Inc., Bridgeport, Conn., a 40-inch sprinkler, a 40-inch, 5-roll Universal calender with chasing attachment and equipped with a 40-inch Mycock cloth expander, a pasting table with plate, furnished by the Textile-Finishing Machinery Company, Providence, R. I.; a 16 by 24 inch bronze-covered stretcher for the drying cans, C. A. Luther & Co., Providence, R. I.; a 40-inch double bristle stretcher for drying cans, American Finishing Machinery Company, Boston, Mass.; a 40-inch Tommy Dodd starch mangle, H. W. Butterworth & Sons Company, Philadelphia, Pa., and a 44-inch, 50 foot vibratory tentering machine. This machine is directly driven by a 7½-horsepower variable speed motor and is equipped with a Schwartz automatic electric guider, made by L. H. A. Schwartz & Co., Boston, Mass.

Engineering Department. — The Steam Engineering Laboratory contains the following equipment arranged for experimental purposes: A 50-horsepower Allis-Chalmers Corliss steam engine direct connected to an Alden absorption dynamometer, and piped to exhaust its steam to the atmosphere, to a Wheeler surface condenser or to the Kerr turbine; a Kerr seven-stage turbine driving directly a 25-kilowatt Richmond Electric Company's alternating current generator and piped to exhaust either to the atmosphere or the condenser. It may be operated either as high pressure or low pressure turbine, and the generator has special connections to illustrate various commercial phases. In addition there are a 4 by 6 Deane triplex power pump, two 2-inch centrifugal pumps made by Lawrence Machine Company, Lawrence, Mass., a Clayton air compressor and necessary tanks, scales and measuring instruments. For the measurement of flow of air there are a steam driven Sturtevant fan and a motor-driven Massachusetts fan with heater combined for heating and drying experiments.

For instruction in leveling and surveying there are provided three engineer's transits, leveling rods, etc.

The Electrical Engineering Laboratory consists of two sections, one of which is devoted to instruction in the generation and transmission of power, and contains the necessary switchboard and instruments to control a 25-kilowatt alternating current turbo generator and a 15-kilowatt motor generator set arranged to supply either direct or alternating current. In addition there are a 24-horsepower direct current Allis-Chalmers motor and a 10-horsepower direct current General Electric motor, also a 10 and a 7.5 horsepower General Electric alternating current motor besides a General Electric 3-kilowatt rotary transformer and three Westinghouse stationary transformers. The other section of the laboratory is known as the instrument laboratory and is for the purpose of giving instruction in the measurement of current voltage, resistance and in the calibration of instruments. It contains a 5-kilowatt Crocker-Wheeler balancer, a 160-ampere hour storage battery, a 5-kilowatt 220-volt to 440-volt General Electric transformer, a Westinghouse portable wattmeter with current and potential transformers, three wattmeters, two ammeters and a voltmeter, all of the General Electric portable alternating current type, a 30-volt alternating current Roller Smith voltmeter, a 5 to 10-scale Weston ammeter (electro dynamometer type), a Weston millivoltmeter with 2, 20, 50 and 200 ampere shunts, three 250-volt direct current Weston voltmeters, a 150-ampere, two model 45, two model 260 Weston portable ammeters, a Weston model 260 voltmeter, a Thompson 50-ampere recording wattmeter, a General Electric rotating standard wattmeter, two General Electric induction type watt hour meters, an Esterline portable curve drawing wattmeter, a 100-ampere Leeds & Northrup Standard Resistance, a Leeds & Northrup Ayrton shunt, a Weston laboratory standard voltmeter with 600-volt multiplier, a Leeds & Northrup potentiometer, a D'Arsonval wall type galvanometer, a Wheatstone bridge with galvanometer, a slide wire bridge, and electrodynamometer, Weston Standard cell, potential phase shifter, a standard Leeds & Northrup photometer with Lummer-Brodhun screen, and Macbeth illuminometer made by the same concern.

Machine Shop. — The equipment of the machine shop is as follows: Four standard engine lathes, 13-inch swing, 6-foot bed, from Flather & Co., Nashua, N. H.; three standard engine lathes, 14-inch swing, 6-foot bed, from Flather & Co., Nashua, N. H.; a standard engine lathe, 15-inch swing, 6-foot bed, from F. E. Reed Company, Worcester, Mass.; an engine lathe, 18-inch swing, 10-foot bed, from Flather & Co., Nashua, N. H.; an engine lathe, 18-inch swing, 6-foot bed, from Champion Tool Works, Cincinnati, Ohio; a standard engine lathe, 15-inch swing, 6-foot bed, from S. H. Putnam Sons, Fitchburg, Mass.; five speed lathes, 17-inch swing, 5-foot bed, from J. G. Blount, Everett, Mass.; one No. 1 Universal milling machine, with all three feeds automatic, from Kempsmith Manufacturing Company, Milwaukee, Wis.; one 24 by 24 inch, 6-foot planer, from the Mark Flather Planer Company, Nashua, N. H.; one 23-inch upright drill, with back gears and power feed, from J. E. Snyder & Son, Worcester, Mass.; one 14-inch single sensitive drill, from the Stanley Manufacturing Company, Lawrence, Mass.; one No. 1 Universal grinder, from Landis Tool Company, Waynesboro, Pa.; one 20-inch wet tool grinder, from J. G. Blount, Everett, Mass.; one 12-inch, 2-wheel dry grinder, from J. G. Blount, Everett, Mass.; an American twist drill grinder, from the Heald Machine Company, Worcester, Mass.; one Type 1B portable electric grinder from the Cincinnati Electric Tool Company, Cincinnati, Ohio; one 30-inch grindstone and frame, from the Athol Machine Company, Athol, Mass.; a single spindle centering machine, from D. E. Whiton Machine Company, New London, Conn.; one 15-inch shaper, from Potter & Johnson, Pawtucket, R. I.; one power hacksaw, from the Fairbanks Company, Boston, Mass.; one cold saw, from John T. Burr & Son, Brooklyn, N. Y.; one Eureka metal power saw, Manning, Maxwell & Moore; one Type CC electric drill, Cincinnati Electric Tool Company; one Universal milling attachment for Kempsmith milling machine, Taylor Machinery Company; one Hisey Type B ½-horsepower tool post grinder, Taylor Machinery Company; one No. 2 Cory bench straightener, Manning, Maxwell & Moore; one No. 3 Universal cutter and reamer grinding machine, Browne and Sharpe; a well-equipped tool room containing a selected stock of the best makes of small tools, such as drills, taps and dies, milling cutters, reamers, gauges, micrometers, etc.

Power, Light, Heat and Ventilating Plant. — In the new power house, completed in 1913, there is located the main power-generating apparatus for supplying light, heat and power to all departments of the school. The equipment here consists of: two 250-horsepower Heine water tube boilers, equipped with Perfection grates, a 300-horsepower Aultman & Taylor horizontal water tube boiler, equipped with United States rocking grates, two boiler feed pumps — one a Knowles and the other a Deane — a 40,000-pound Cochrane metering open-feed heater, which is provided with a Lea recorder, and a Cochrane oil extractor heats and measures all feed water, a 3-inch Venturi meter in feed line with indicating manometer as made by the Builders Iron Foundry, Providence, R. I. In the Engine Room are located: a Payne 14 by 14 automatic high speed engine, 125-horsepower direct connected to 75-kilowatt, 220-volt, direct-current Bullock generator, a 9½ by 11 Nash gas engine of 50-horsepower, 4-cycle type, with speed-regulating clutch and a "hit and miss" governor, direct connected to a 30-kilowatt, 220-volt, direct-current Bullock generator, a 65-kilowatt motor generator set, consisting of a direct current motor and an alternating current generator. This unit may be run either A. C. to D. C. or D. C. to A. C., and was made by the Westinghouse Electric and Manufacturing Company. A steam-driven Ingersoll-Rand 8 by 8 air compressor, for use with Turbo heads, installed in the French Spinning Department by the G. M. Parks Company, Fitchburg, Mass., a 5½ to 6 motor-driven air compressor, with 20 cubic foot storage tank for use in starting Nash gas engine, a Cross oil filter. The station switchboard is of marine-finished slate, 90 inches in height, and consists of three generator panels and two circuit panels.

The power house is connected with the main school buildings by a tunnel through which all wires, steam and water pipes are carried. The steam pipes supply heat to the buildings by means of direct radiation, and by means of the Sturtevant double duct heating and ventilating system located in the basement of Southwick Hall, and by the Sturtevant fan and heater located in the basement of Kitson Hall. Direct-driven exhaust fans are placed on the roof of Southwick Hall and in the basement laboratories.

GRADUATES, JUNE 7, 1927

Graduates, with Titles of Theses

Bachelor of Textile Chemistry

William Francis Brosnan, Lowell, Mass. "A Study of the Effects upon the Fiber of the Alkaline Reagents used in Viscose Processing."

Thomas Henry Flood, Lowell, Mass. "The Effect of High Temperature and Pressure on Dyeing."

Bernhardt Brecher Glickman, Dorchester, Mass. "The Immunization of Cotton."

Clarence Hooper, Shirley, Mass. "A Study of the Products formed by the Coupling of Diazotized Aromatic Amines to the Flourescein Configuration." Thesis with Chester W. Meyers.

Samuel Meeker, Lowell, Mass. "A Study of Certain Amino Derivatives of Acridine and Some Related Compounds."

Chester William Meyers, Billerica, Mass. Thesis with Clarence Hooper.

Thomas Joseph Tarpey, Somerville, Mass. "New Dyes Derived from Acenaphthene."

Bachelor of Textile Engineering

Jerome Franks, Brooklyn, N. Y. "An Investigation to Determine the Effect of Age upon the Strength of a Cotton Yarn." Thesis with Charles S. Parsons.

Louis Goldenberg, Boston, Mass. "Development of a Device to Measure the Tension in a Yarn During Spinning."

Lawrence Winfield Guild, Quincy, Mass. "An Investigation to Determine the Possibility of using an Illuminometer to Distinguish between Different Finishes on a Cotton Cloth." Thesis with Kenneth L. Woodbury.

John Leslie Merrill, Lowell, Mass. "A Determination of the Relation between Yarn Strength and Fabric Strength."

Robert Wilson Parkin, Maynard, Mass. "A Study of the Relation between Various Characteristics of Commercial Knit Underwear Fabrics."

Charles Sumner Parsons, East Milton, Mass. Thesis with Jerome Franks.

Richard Morey Sawyer, Winchester, Mass. "A Study of the Effect of Changing the Speed of the Cylinder of a Card, Keeping the Other Parts at a Constant Speed, on the Strength and Elongation of the Yarn."

Diploma Graduates

Cotton Manufacture

Leo Edward Leonard, Worcester, Mass. "A Comparative Test of Drawn and Combed Yarn."

Wool Manufacture

Leo Joseph Barry, Cambridge, Mass. "The Manufacture of a Close Finished Worsted Suiting."

Howard Seymour Bronson, Portage, Wis. "The Manufacture of a Knitted Overcoating."

James Barber Dods, Alton, Ont. "The Manufacture of a Knitted Overcoating."

Benjamin Feinberg, Newton Centre, Mass. "The Manufacture of a Woolen Cassimere."

John Waters Gallagher, Danbury, Conn. "The Manufacture of a Woolen Suiting."

John Roger Greenwood, Jr., Millbury, Mass. "The Manufacture of a Woolen Cheviot."

Edwin Thomas Hanscom, Sanford, Me. "The Manufacture of a Woolen Suiting."

Frederick Leo Kenney, Franklin, Mass. "The Manufacture of a Woolen Suiting."

Joseph Adrien Lussier, Woonsocket, R. I. "The Manufacture of a Woolen Suiting."
David Louis Ryan, Natick, Mass. "The Manufacture of a Woolen Cheviot."
Roger Dennis Smith, Haverhill, Mass. "The Manufacture of a Cheviot Suiting."
John George Stass, Lowell, Mass. "The Manufacture of a Woolen Cassimere."

Textile Design

John Joseph Connorton, Jr., Concord Junction, Mass. "The Manufacture of a Worsted Suiting."
Jacob Schneiderman, Dorchester, Mass. "The Manufacture of a Worsted Suiting."

Prizes awarded in June 1927

Locks and Canals Scholarship for advanced degrees at Massachusetts Institute of Technology. To *Richard Morey Sawyer.*

Textile Colorist Award of $100 offered to a member of the graduating class whose thesis, based upon his personal researches and experiences, is of the greatest practical value to the dyeing, bleaching or textile finishing industries. Divided between *Samuel Meeker* and *Thomas Joseph Tarpey.*

The Medal of the National Association of Cotton Manufacturers awarded to the student taking course in Cotton who maintains the highest average in scholarship throughout this course. To *Richard Morey Sawyer.*

Edward A. Bigelow Prize of $100 to the member of the graduating class from the Wool Manufacturing course who maintains the highest standing throughout his three years. To *Edwin Thomas Hanscom.*

Edward A. Bigelow Prize of $50 to the member of the second year class in the Wool Manufacturing course who maintains the highest standing during his second year. To *Walter Urban Gaudet.*

Edward A. Bigelow Prize of $25 to the member of the first year class in the Wool Manufacturing course who maintains the highest standing during his first year. To *Joseph Johnson Brook.*

Louis A. Olney Prizes (in the form of books).

$20 to the regular student in the Chemistry and Textile Coloring Course who shall present the best thesis preparatory to graduation. To *William Francis Brosnan.*

$10 to the regular student of the Chemistry and Textile Coloring course who shall be considered as having attained the highest scholarship during his second year. To *Earle Raymond McLean.*

$5 to the regular student of the Chemistry and Textile Coloring course who shall be considered as having attained the second highest scholarship during his second year. To *Alvin Wilfred Bergeron.* Honorable Mention, *Amos Kempton Haynes.*

$10 to the student taking the regular Chemistry and Textile Coloring course who shall be considered as having attained the highest scholarship in first-year Chemistry. To *Arthur Francis Gallagher.*

$5 to the student taking the regular Chemistry and Textile Coloring course who shall be considered as having attained the second highest scholarship in first-year Chemistry. To *Bliss Morris Jones.* Honorable Mention, *Bernard Livingstone* and *Morris Barsky.*

Herbert A. Currier Scholarship. — $100 given by Herbert A. Currier of the Class of 1906 to a student selected by the faculty of the school, the following conditions to be considered in making the selection: scholastic standing, financial need, and ability in promoting student activities in school life. To *James Francis Corbett.*

REGISTER OF DAY STUDENTS

Candidates for Degree

Class of 1928

Name	*Home Address*	*Lowell Address*
Burns, Robert, IV,	Easthampton, Mass.	Phi Psi House
Corbett, James Francis, IV,	Dracut, Mass.	———
Dolan, William Francis, IV,	Lowell, Mass.	56 Crowley Street
Farley, Clifford Albert, VI,	Lowell, Mass.	215 Princeton Street
Fasig, Paul Leon, IV,	Lowell, Mass.	125 Mt. Washington Street
Fitzgerald, John Francis, IV,	Lawrence, Mass.	———
Ford, Stephen Kenneth, IV,	Haverhill, Mass.	———
Gottschalck, Lawrence, VI,	Lowell, Mass.	Omicron Pi House
Holbrook, Ralph Wentworth, IV,	Allston, Mass.	141 Pawtucket Street
Killheffer, John Vincent, IV,	Lowell, Mass.	Phi Psi House
Lindsly, Walter Coburn, IV,	Lowell, Mass.	49 Nesmith Street
Logan, George Leslie, VI,	Lowell, Mass.	Phi Psi House
McGuire, Edward Perkins, VI,	Chestnut Hill, Mass.	14 Mt. Washington Street
McKay, Benedict Josephus, IV,	Stoughton, Mass.	347 Westford Street
McKinnon, Norman, VI,	Lowell, Mass.	179 Princeton Street
McKittrick, Raymond Wellington, VI,	Lowell, Mass.	15 Hawthorne St.
Osborne, George Gordon, VI,	Washington, Conn.	63 Varnum Avenue
Parigian, Harold Hrant, IV,	Hudson, Mass.	559 Fletcher Street
Reinhold, Kurt Herman, VI,	Lowell, Mass.	Phi Psi House
Rodalvicz, Francis Rudolph, IV,	Anthony, R. I.	Delta Kappa Phi House
Russell, William Samuel, Jr., VI.,	Haverhill, Mass.	———
Sampson, Clifford William, IV,	Plymouth, Mass.	Phi Psi House
Shea, John Francis, IV,	Fitchburg, Mass.	Delta Kappa Phi House
Stanley, John Prince, Jr., IV,	Lewiston, Me.	197 Appleton Street
Storey, Alvin Briggs, VI,	Lowell, Mass.	Phi Psi House
Tarshis, Elias Aaron, IV,	Springfield, Mass.	749 Merrimack Street
Ward, George Chester, IV,	Andover, Mass.	———
Warren, Eva Maybelle, IV,	Billerica, Mass.	———
Westaway, John Chester, VI,	Hamilton, Ont.	Phi Psi House
Wingate, Edward Lawrence, Jr., VI,	Malden, Mass.	Omicron Pi House
Woodbury, Kenneth Leroy, VI,	Bradford, Mass.	Phi Psi House

Class of 1929

Anderson, Alfred Ballard, VI,	Framingham, Mass.	Omicron Pi House
Anderson, Harry Eric, VI,	Lowell, Mass.	39 Daniels Street
Balch, Ralph Herman, VI,	Billerica, Mass.	———
Beardsell, Arthur Herrick, VI,	Concord, Mass.	43 Plymouth Street
Bergeron, Alvin Wilfred, IV,	Haverhill, Mass.	———
Birdsall, Edgar Wallace, IV,	Southbridge, Mass.	Omicron Pi House
Buzzell, Harry Saville, VI,	Lowell, Mass.	30 Highland Avenue
Ellis, James Oliver, VI,	Chelmsford, Mass.	———
Fairweather, John Ross, VI,	Jackson Heights, N. Y.	Omicron Pi House
Hale, Everett Lane, VI,	Stoneham, Mass.	———
Haynes, Amos Kempton, IV,	Haverhill, Mass.	Phi Psi House
Hetherman, Patrick Joseph, IV,	Lowell, Mass.	306 School Street
Holt, Laurence Currier, VI,	Lexington, Mass.	43 Plymouth Street
Howorth, Harmon, VI,	Lowell, Mass.	57 Dover Street
Hurd, Ira Swain, IV,	Haverhill, Mass.	Omicron Pi House
Hyun, Chirl, VI,	Kai Chun, Korea	272 Merrimack Street
Johnstone, Edwin Parker, Jr., IV,	New Haven, Conn.	51 Sixth Avenue
Konieczny, Henry, IV,	Dracut, Mass.	———
Larter, Edward Alan, VI,	Lowell, Mass.	43 Plymouth Street
McGibbon, James Greig, IV,	Lexington, Mass.	137 Riverside Street
McLean, Earle Raymond, IV,	Haverhill, Mass.	Delta Kappa Phi House

Matthews, Robert Jackson, VI, Gardner, Mass.	Omicron Pi House
Murphy, Sylvester, IV, Allerton, Mass.	Phi Psi House
Myers, Walter Flemings, VI, Lowell, Mass.	21 Albert Street
Phelan, Bernard Michael, IV, Ipswich, Mass.	Delta Kappa Phi House
Ray, Lloyd Sanford, IV, West Newbury, Mass.	3 Belmont Street
Rice, Kenneth Earl, VI, Stoneham, Mass.	———
Robbins, Walter Archibald, VI, Lowell, Mass.	102 South Loring Street
Ryberg, Bertil August, IV, Centerville, Mass.	Phi Psi House
Shelton, Charles Leopold, VI, Boston, Mass.	———
Simmons, Osborne Arthur, VI, Lowell, Mass.	3 Branch Avenue
Stacey, Alfred Charles, IV, Andover, Mass.	———
Stewart, John Weeden, IV, Brattleboro, Vt.	Phi Psi House
Westbrooke, Clayton Collington, IV, North Andover, Mass.	———
Weich, Raymond Edward, IV, Lowell, Mass.	54 Hoyt Avenue
Zalkind, Benjamin Joseph, VI, Dorchester, Mass.	———

Class of 1930

Barsky, Morris, IV, Dorchester, Mass.	28 Mount Vernon Street
Bates, John Alden, IV, Bradford, Mass.	Delta Kappa House
Beeman, Earl Royal, VI, Quincy, Mass.	Omicron Pi House
Cappabianca, Libero Frank, VI, Haverhill, Mass.	———
Carbone, Alfred John, IV, Haverhill, Mass.	———
Casey, Francis Harold, IV, Roslindale, Mass.	37 Varney Street
Cleveland, Richard Sumner, VI, Pepperell, Mass.	———
Colby, Willard Alvah, Jr., IV, Bradford, Mass.	———
Dunlap, Kirke Harold, Jr., VI, Lowell, Mass.	72 Fort Hill Avenue
French, Wallace Howe, IV, Lowell, Mass.	636 Rogers Street
Gallagher, Arthur Francis, IV, Lowell, Mass.	36 Merrill Street
Greendonner, George John, IV, Stafford Springs, Conn.	63 Varnum Avenue
Gross, Herman Harold, IV, Newark, N. J.	Phi Psi House
Jones, Bliss Morris, IV, Lexington, Mass.	Omicron Pi House
Jones, Mellor Adair, IV, Bridgeport, Conn.	Omicron Pi House
Kolsky, Samuel Irving, IV, Lawrence, Mass.	———
Kostopoulos, Emanuel Arthur, VI, Lowell, Mass.	270 Adams Street
Krishan Maharaj, VI, Montgomery, India	43 Plymouth Street
Livingstone, Bernard Nathaniel,IV, Woodstock, Vt.	Delta Kappa Phi House
McDonald, Gerald Francis, IV, Lowell, Mass.	208 Mount Hope Street
McGee, Francis Patrick, IV, Lowell, Mass.	94 Beacon Street
Meady, Benjamin Balch, IV, Lexington, Mass.	———
Orlauski, Anthony, IV, Haverhill, Mass.	48 Hawthorn Street
Parker, John George, Jr., IV, Chelmsford, Mass.	———
Preston, Harold Lawrence, VI, Wakefield, Mass,	272 Merrimack Street
Rand, Ralph Frederick, VI, Lowell, Mass.	495 Central Street
Ross, William Cummings, IV, Embo, Scotland	661 Rogers Street
Sadler, Thomas Sheridan, VI, Billerica, Mass.	———
Tamulonis, Edward William, VI, Nashua, N. H.	———
Topjian, Leon, IV, Lowell, Mass.	98 Fremont Street

Class of 1931

Allard, Edward Joseph, IV, Lowell, Mass.	116 Ennell Street
Anthony, Louis Lowell, IV, Lowell, Mass.	20 Loring Street
Bagshaw, Herbert Arthur, VI, Lowell, Mass.	92 Jenness Street
Bradford, William Swanton, VI, Andover, Mass.	———
Brook, Richard Lea, IV, Simcoe, Ont.	118 Mt. Washington Street
Burtt, Joseph Frederic, VI, Lowell, Mass.	385 Walker Street
Campbell, Allan, Jr., VI, South Boston, Mass.	37 Varney Street
Churchill, George Richards, VI, Atlantic, Mass.	142 Riverside Street
Cook, Vernon Stanley, VI, Lowell, Mass.	43 Twelfth Street

Danahy, Arthur Joseph, IV, Lowell, Mass.	37 Clark Street
Duggan, Paul Curran, IV, Lowell, Mass.	58 D Street
Grant, Alfred Thomas, IV, Somersworth, N. H.	37 Varney Street
Hale, Eugene Heffley, VI, Stoneham, Mass.	———
Hale, Ralph Edgar, IV, West Newbury, Mass.	272 Merrimack Street
Hall, Stanley Arundel, IV, Haverhill, Mass.	———
Hannafin, Thomas George, VI, Lowell, Mass.	15 Sargent Street
Hardman, Joseph Edwin, IV, Lowell, Mass.	485 Westford Street
Harrington, Richard Mangan, IV, Lowell, Mass.	127 Hildreth Street
Hosmer, Frank Barbour, IV, Lowell, Mass.	226 Gibson Street
Ivers, Gerald Anthony, IV, East Chelmsford, Mass.	———
Jarek, Julius, IV, Lowell, Mass.	74 Eleventh Street
Johnson, Norman Albin, IV, Deep River, Conn.	142 Riverside Street
Korman, Frank IV, South Manchester, Conn.	37 Varney Street
Lathrop, John Francis, IV, South Manchester, Conn.	137 Riverside Street
Lifland, Abraham, IV, Roxbury, Mass.	———
Loveless, Everton Hanscom, VI, Melrose, Mass.	66 Meridian Street
Maher, Margaret Mary, IV, Lowell, Mass.	172 Chapel Street
McAllister, Gordon, IV, North Billerica, Mass.	———
McDonald, John Joseph, IV, Lowell, Mass.	208 Mount Hope Street
McPeake, Frank J., Jr., VI, Lexington, Mass.	———
Morse, Richard Hale, VI, Haverhill, Mass.	———
O'Brien, Daniel Joseph, Jr., VI, Lowell, Mass.	90 Parkview Avenue
Peirce, Charles Horace, VI, Arlington, Mass.	———
Pero, Richard Omer, VI, Monson, Mass.	43 Plymouth Street
Peterson, Eric Arthur, IV, Lowell, Mass	14 Winthrop Avenue
Piligian, Hiag Nishan, IV, Springfield, Mass.	118 Mount Washington St.
Quigley, Gerald Francis, IV, Lowell, Mass.	51 Crawford Street
Rawlinson, Richard William, VI, Lowell, Mass.	430 Pine Street
Remick, Charles Wheeler, VI, Andover, Mass.	———
Russell, Harold William, VI, Sanford, Me.	142 Riverside Street
Stevens, Herbert, IV, Lawrence, Mass.	———
Stewart, Alexander, VI, Andover, Mass.	———
Stifel, Edward William, Jr., IV, Wheeling, W. Va.	524 Moody Street
Sullivan, Joseph Michael, IV, Lowell, Mass.	28 Dunfey Street
Sung, Harvey, VI, Tsinanfu, China	137 Riverside Street
Toher, Francis Luke, IV, Providence, R. I.	524 Moody Street
Verry, Richard Morton, VI, Salem, Mass.	137 Riverside Street
Wallace, Max Joseph, IV, Malden, Mass.	———
Wiggin, Glenn Marshall, VI, Methuen, Mass.	———

Diploma Students

Class of 1928

Bauer, Harold Conrad, III, Lawrence, Mass.	———
Biggi, Harrison Andrew, III, Bedford, Mass.	———
Billings, Borden Dickinson, I, Auburndale, Mass.	141 Pawtucket Street
Bottomley, John, III, North Andover, Mass.	———
Burtt, Richard Flint, II, Lowell, Mass.	385 Walker Street
Campbell, William Malcolm, III, South Boston, Mass.	37 Varney Street
Coffey, Daniel Joseph, III, Pittsfield, Mass.	Delta Kappa Phi House
Connor, Thomas Francis, II, Boston, Mass.	503 Beacon Street
Darby, Avard Nelson, II, Billerica, Mass.	———
Davidson, Sydney, III, Roxbury, Mass.	———
Evans, Paul Richard, II, Stoneham, Mass.	———
Ferris, Arthur Leon, II, Port Rowan, Ont.	Phi Psi House
Gaudet, Walter Urban, II, Pawtucket, R. I.	115 Mt. Vernon Street
Hyman, Wolfred, II, Roxbury, Mass.	90 Mount Vernon Street
Joslin, Harold Wheeler, II, Milford, N. H.	51 Sixth Avenue
MacKinnon, Howard Arthur, III, Roslindale, Mass.	37 Varney Street
Maguire, James Joseph, II, North Attleboro, Mass.	141 Pawtucket Street

Pearlstein, Maxwell, III, Dorchester, Mass.	37 Varney Street
Pease, Cecil Jay, II, Lowell, Mass.	272 Merrimack Street
Shedd, Jackson Ambrose, III, Nabnassett, Mass.	———
Stott, John Smith, III, North Andover, Mass.	———
Strout, Kenneth Edward, III, South Portland, Me.	37 Varney Street
Swanson, John Harold, I, Griffin, Ga.	Delta Kappa Phi House
Wetherbee, Francis Putney, I, Albany, Ga.	100 Riverside Street

Class of 1929

Brook, Joseph Johnson, II, Simcoe, Ont.	118 Mt. Washington Street
Carpenter, Carleton Warner, II, Lowell, Mass.	14 Staples Street
Cluett, John Girvin, I, Troy, N. Y.	153 Westford Street
Glidden, Reginald Williams, III, Madison, Me.	Phi Psi House
Greenbaum, Herbert Baron, III, Roxbury, Mass.	749 Merrimack Street
Kilton, Lyman Hayward, Jr., II, Chelmsford, Mass.	———
Stephens, Arnold George, I, Roslindale, Mass.	37 Varney Street
Stewart, Earl Stanley, II, Somerville, Mass.	———

Class of 1930

Bacon, Charles Fullerton, Jr., II, Providence, R. I.	37 Varney Street
Bowman, Lee Dascombe, II, Springfield, Vt.	16 Plymouth Street
Carleton, Joseph Raddin, III, Bradford, Mass.	98 Mount Vernon Street
Cole, Russell, Jr., III, Nashua, N. H.	———
Currier, Leslie Frank, III, Lowell, Mass.	234 Parker Street
Garner, Allen Frank, II, Kezar Falls, Me.	98 Mount Vernon Street
Goulson, Walter Seth, III, Lowell, Mass.	99 Sayles Street
Hunter, Charles Hannibal, II, Anson, Me.	272 Merrimack Street
Kilmartin, John Joseph, I, Lowell, Mass.	62 Highland Avenue
Lanier, Joseph Lamar, I, West Point, Ga.	26 Hanks Street
Peary, John Ervin, III, Wilton, Me.	793 Merrimack Street
Preston, John Cutler, III, Lowell, Mass.	19 Bertram Street

Special Students

Blakeley, Frances, III, Lowell, Mass.	900 Gorham Street
Blessington, John James, II, Lowell, Mass.	53 Second Avenue
Boudreau, Gilbert, IV, Lowell, Mass.	53 Mount Hope Street
Enright, Edward Barth, III, Nashua, N. H.	———
Fleisher, Arnold Melville, III, Brookline, Mass.	123 Riverside Street
Fredrickson, Charles Joseph, Jr., IV, Andover, Mass.	———
Frost, Robert Jones, II, East Douglas, Mass.	100 Riverside Street
Hope, Gordon Raymond, I, Melrose, Mass.	———
Langlois, Ovila Eugene, III, Stottsville, Que.	41 Mount Vernon Street
Marble, Roger Houghton, VI, Worcester, Mass.	Phi Psi House
Perlitz, Fred William, VI, Houston, Texas	123 Riverside Street
Robertson, William Frederick, Jr., IV, Lowell, Mass.	197 Appleton Street
Salisbury, Clarence Linwood, III, Moosup, Conn.	142 Riverside Street
Saraiya, Anandji Laxmidas, III, Bhuj, India	35 Mount Vernon Street
Schmidt, Otto Emil, Jr., IV, Lawrence, Mass.	———
Walker, Ian Campbell, II, South Gardner, Mass.	Omicron Pi House
Windle, Winfred Woodward, II, Millbury, Mass.	272 Merrimack Street

ALPHABETICAL LIST OF GRADUATES

The following list has been corrected in accordance with information received previous to February 1, 1928. Any information regarding incorrect or missing addresses is earnestly solicited.

B.T.C. indicates the degree of Bachelor of Textile Chemistry; B.T.D. indicates the degree of Bachelor of Textile Dyeing; B.T.E. indicates the degree of Bachelor of Textile Engineering; D indicates a diploma; C indicates a certificate (covering a partial course only). Degrees were issued beginning with the year 1913.

Abbot, Edward Moseley, II, '04 (D). Manufacturer, Abbot Worsted Company, Graniteville, Mass.

Abbott, George Richard, II, '08 (D). Andover, Mass.

Adams, Floyd Willington, VI, '16 (B.T.E.). Superintendent, The Barrett Company, Peoria, Ill.

Adams, Henry Shaw, I, '05, (D). Secretary and Treasurer, Eureka Cotton Mills and The Springstein Mills, Chester, S. C.

Adams, Tracy Addison, IV, '11 (D). General Manager, Arnold Print Works, North Adams, Mass.

Albrecht, Charles Henry, IV, '17 (B.T.C.). Chemist, Bell Company, Worcester, Mass.

Almquist, George John Edwin, I, '19 (D). Manager, Passaic-Bergen Lumber Company, Ridgewood, N. J.

Anderson, Arthur Illman, IV, '24 (B.T.C.) Chemist, with R. G. Knowland, Chemical Engineer, 88 Broad Street, Boston, Mass.

Anderson, Arthur Julius, IV, '19 (B.T.C.). Salesman and Demonstrator, National Aniline and Chemical Company, 40 Rector Street, New York City.

Anderson, Clarence Alfred, VI, '25 (B.T.E.). Methods Department, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.

Anderson, Harold Robert, II, '26 (D). Assistant Sales Manager, American Mason Safety Tread Company, Lowell, Mass.

Annan, David, II, '23 (D). Overseer, Union Textile Corporation, Worcester, Mass.

Arienti, Peter Joseph, IV, '10 (D). Chief Chemist and Dyer, Sayles Finishing Plants, Inc., Saylesville, R. I.

Arundale, Henry Barnes, II, '07 (D). Research and Inspection Department, United States Testing Company, Inc., 316 Hudson Street, New York City.

Atwood, Henry Jones, II, '23 (D). Assistant Designer, Leominster Worsted Company, Leominster, Mass.

Avery, Charles Henry, II, '06 (D). Died January, 1913.

Babigan, Raymond, IV, '24 (B.T.C.). Junior Examiner, United States Patent Office, Washington, D. C.

Bachelder, Charles Edward, IV, '24 (B.T.C.). Plant Chemist, Slatersville Finishing Company, Slatersville, R. I.

Bailey, Joseph W., I, '99 (D). Agent, Booth Manufacturing Company, New Bedford, Mass.

Bailey, Lester Harold, IV, '24 (B.T.C.). Textile Chemist, Pacific Mills, Lawrence, Mass.

Bailey, Walter James, IV, '11 (D). Bailey's Cleansers and Dyers, Watertown, Mass.

Baker, Franz Evron, VI, '26 (B.T.E.). Research Department, Cotton Research Company, Boston Mass.

Baker, Maurice Sidney, IV, '25 (B.T.C.). Merchant, Attleboro, Mass.

Baker, William John, IV, '16 (D). 136 West Hazeltine Street, Kenmore, N. Y.

Baker, William Samuel, I, '26 (D). With Nashua Manufacturing Company, Nashua, N. H.

Baldwin, Arthur Lincoln, IV, '00 (D). Died December 1, 1919.

Baldwin, Frederick Albert, II, '04 (D). Vice-President and Secretary, Walter Blue & Co., Ltd., Sherbrooke, Que.

Ballard, Horace W. C. S., IV, '08 (D). Died September 28, 1918.

Experimental Dyeing Laboratory

Barlofsky, Archie, VI, '17 (B.T.E.). Merchant, Economy Cash Market, 165 Chelmsford Street, Lowell, Mass.

Barr, I. Walwin, I, '00 (D). With Buckley Brothers, 881 Broadway, New York City.

Barrett, Andrew Edward, IV, '23 (B.T.C). Dyer, Bradford Dyeing Association, Bradford, R. I.

Barry, Leo Joseph, II, '27 (D). With Wuskanut Mills, Inc., Farnumsville, Mass.

Beck, Frederic Christian, II, '24 (D). In business, Weld & Beck, Southbridge, Mass.

Bell, Edward Benjamin, IV, '24 (B.T.C.). Overseer of Dyeing, Faulkner & Colony Manufacturing Co., Keene, N. H.

Bennett, Edward Howard, II, '03 (C). Publisher, American Wool and Cotton Reporter, 530 Atlantic Avenue, Boston, Mass.

Bennett, Herbert Bowen, II, '13 (D). Died January 23, 1920.

Bentley, Byron, II, '26 (D). With Joseph Bentley Hair Company, Methuen, Mass.

Berry, Wilbur French, II, '17 (D). Treasurer and General Manager, Wilbur Manufacturing Company, Providence, R. I.

Bienstock, George Jerrard, III, '24 (D). Styler and Designer, Henry W. T. Mali & Co., 25 Madison Avenue, New York City.

Bigelow, Prescott Fenno, II, '12 (D). Died October 14, 1918.

Bird, Clarence Henry, II, '22 (D). Assistant Superintendent, Worcester Woolen Mill Company, Worcester, Mass.

Bird, Francis John, VI, '22 (B.T.E.). 30 West Street, Attleboro, Mass.

Blaikie, Howard Mills, II, '11 (D). Salesman, American Woolen Company, 225 4th Avenue, New York City.

Blake, Parker Gould, VI, '14 (D). District Manager, Claude Denis & Co., Ltd., Toronto, Ont.

Blanchard, John Lawrence, II, '23 (D). With Pondicherry Woolen Company, Bridgton, Me.

Bloom, Wilfred Nathaniel, IV, '03 (D). Died August 17, 1918.

Bodwell, Henry Albert, II, '00 (D). Treasurer and Sales Manager, Smith & Dove Manufacturing Company, Andover, Mass.

Booth, James Mooney, IV, '24 (B.T.C.). Salesman, The Huron Milling Company, Inc., 9 Park Place, New York City.

Boyd, George Andrew, I, '05 (D). Treasurer, Appleton Company, 79 Milk Street, Boston, Mass.

Boylston, Theodore Willmott, IV, '21 (B.T.C.). Died June 3, 1921.

Brackett, Martin Richard, II, '22 (D). Styler and Salesman, D. S. Mackay & Co., 215 Fourth Avenue, New York City.

Bradford, Harold Palmer, II, '25 (D). 90 Beach Street, Malden, Mass.

Bradford, Roy Hosmer, II, '06 (D). Salesman, H. M. McCord & Co., 505 Fifth Avenue, New York City.

Bradley, Raymond Frost, VI, '14 (D). Garage Proprietor, Twin Light Garage Company, 267 East Main Street, Gloucester, Mass.

Bradley, Richard Henry, V, '01 (C). Overseer, Wamsutta Manufacturing Company, New Bedford, Mass.

Brainerd, Arthur Travena, IV, '09 (D). Manager, Chicago Office, Ciba Company, 233 West Huron Street, Chicago, Ill.

Brainerd, Carl Emil, IV, '20 (B.T.C.). Overseer of Dyeing, F. C. Huyck & Sons, Albany, N. Y.

Brainerd, Carroll Lewis, IV, '19 (B.T.C.). With Waldrich Bleachery, Delawanna, N. J.

Brandt, Carl Dewey, VI, '20, (B.T.E.). With Lowell Bleachery South, Experiment, Ga.

Brannen, Leon Vincent, III, '07 (C).

Brickett, Chauncy Jackson, II, '00 (D). Director, School of Textiles, International Correspondence School, Scranton, Pa.

Brickett, Raymond Calvin, II, '14 (D). Overseer, M. T. Stevens & Sons Company (Marland Mills), Andover, Mass.

Brigham, Howard Mason, VI, '24 (B.T.E.). With Hunter Manufacturing and Commission Company, 60 Worth Street, New York City.

Bronson, Howard Seymour, II, '27 (D). Overseer of Knitting, Portage Hosiery Company, Portage, Wis.

Brosnan, William Francis, IV, '27 (B.T.C.). Chemist and Dyer, Price Fire and Waterproofing Co., Poughkeepsie, N. Y.

Brown, Gerald Marston, VI, '22 (B.T.E.). With Monomac Spinning Company, Lawrence, Mass.

Brown, Phillip Franklin, II, '23 (D). District Sales Manager, DuPont Rayon Company, Buffalo, N. Y.

Brown, Rollins Goldthwaite, IV, '12 (D). Sales Representative, White Brothers, Inc., Winchendon Springs, Mass.

Brown, Russell Lee, VI, '21 (B.T.E.). Assistant Superintendent, M. T. Stevens & Sons Co., Franklin, N. H.

Brown, Will George, Jr., IV, '22 (B.T.C.) Chemist, American Hide & Leather Company, Lowell, Mass.

Buchan, Donald Cameron, II, '01 (D). Assistant Superintendent, M. T. Stevens & Sons Company, North Andover, Mass.

Buchan, Norman Spaulding, IV, '26 (B.T.C.). Overseer of Dyeing, Pitman Manufacturing Company, Laconia, N. H.

Burbeck, Dorothy Maria, IV, '20 (B.T.C.). See Garlick, Mrs. Dorothy M.

Burger, Samuel Joseph, III, '24 (D). With Harrison Studio, Harrison, N. Y.

Burnham, Frank Erwin, IV, '02 (D). Chief Chemist, Farwell Bleachery, Lawrence, Mass.

Burrage, Katharine C., IIIb, '99 (C). Died May 16, 1914.

Callahan, John Joseph, Jr., II, '26 (D). With Arlington Mills, Lawrence, Mass.

Cameron, Elliott Francis, IV, '11 (D). Treasurer, Amos F. Chase Company, Inc., 13 Otis Street, Boston, Mass.

Campbell, Alexander, VI, '23 (B.T.E.). Resident Engineer, John A. Stevens, Engineer, 16 Shattuck Street, Lowell, Mass.

Campbell, Laura Etta, IIIb, '00 (C). Deceased.

Campbell, Louise Porter, IIIb, '03 (C). With Ginn & Co., 15 Ashburton Place, Boston, Mass.

Campbell, Orison Sargent, II, '03 (D). Manager Felt Department, Canadian Consolidated Felt Company, Ltd., Kitchener, Ont.

Cannell, Philip Stuart, VI, '23 (B.T.E.). Safety Engineer, Employers Liability Assurance Corporation, New Haven, Conn.

Carr, George Everett, I, '05 (D).

Carr, Paul Edward, II, '24 (D). Designer, Camden Woolen Company, Camden, Me.

Carter, Robert Albion, IV, '02 (D). Salesman, E. I. du Pont de Nemours & Co., 128 South Front Street, Philadelphia, Pa.

Carter, Russell Albert, II, '25 (D). Planning Department, Dennison Manufacturing Company, Marlboro, Mass.

Cary, Julian Clinton, VI, '10 (D). Branch Manager, American Mutual Liability Insurance Company, 226 Pearl Street, Hartford, Conn.

Caya, Ferdinand Joseph, IV, '22 (B.T.C.). Superintendent of Dyeing, Gotham Silk Hosiery Company, Inc., Wharton, N. J.

Chamberlin, Frederick Ellery, I, '03 (D). Overseer of Spinning, Monument Mills, Housatonic, Mass.

Chandler, Proctor, IV, '11 (D). President and Manager, Chandler Manufacturing Company, 28 Carleton Street, Cambridge, Mass.

Chang, Chi, VI, '23 (B.T.E.).

Chang, Wen Chuan, VI, '21 (B.T.E.). Dah Sung Cotton Mill No. 1, Nantung, Kiangsu, China.

Chapman, Leland Hildreth, VI, '24 (B.T.E.). Principal, Ashby High School, Ashby, Mass.

Chen, Shih Ching, IV, '22 (B.T.C.). Hou Sung Cotton Mill, Shanghai, China.

Chen, Wen-Pei, IV, '24 (B.T.C.).

Chisholm, Lester Bury, I, '11 (D). General Plant Manager, Everlastik, Inc., Chelsea, Mass.
Church, Charles Royal, II, '06 (C).
Churchill, Charles Whittier, III, '06 (D). Manager, Churchill Manufacturing Company, Inc., Lowell, Mass.
Clapp, Frank Austin, II, '04 (D).
Clark, Earl William, IV, '18 (B.T.C.). Chemist, Comstock & Wescott, Inc., Niagara Falls, N. Y.
Clark, Thomas Talbot, II, '10 (D). Treasurer, Talbot Mills, North Billerica, Mass.
Clarke, George Dean, II, '21 (C). Dyer, Seamans & Cobb Thread Mills, Hopkinton, Mass.
Clayton, Harold Edmund, VI, '21 (B.T.E.). Superintendent, Bottum & Torrance Co., Bennington, Vt.
Cleary, Charles Joseph, II, '13 (D). Textile Technologist, United States Army Air Service, Wright Field, Dayton, Ohio.
Clement, David Scott, IV, '24 (B.T.C.). With Braemor Mills, Inc., Pascoag, R. I.
Clifford, Albert Chester, VI, '22 (B.T.E.). Textile Engineer, Western Electric Company (Hawthorne Works), Chicago, Ill.
Clogston, Raymond B., IV, '04 (D). Superintendent of Dyeing, Merrimack Manufacturing Company, Lowell, Mass.
Coan, Charles Bisbee, IV, '12 (D).
Cohen, Arthur Edward, IV, '23 (B.T.C.).
Cohen, Raphael Edvab, IV, '25 (B.T.C.). With Gotham Silk Hosiery Company, New York City.
Colby, James Tracy, VI, '16 (D). Salesman, F. C. Huyck & Sons, Albany, N. Y.
Cole, Edward Earle, IV, '06 (D). Financial Agent, The Bradstreet Company, Boston, Mass.
Cole, James Thomas, II, '05 (D). Treasurer, Arlington Industries for the Blind, Arlington, Mass.
Collonan, Herbert Joseph, II, '22 (D). Assistant Designer, Beoli Mills, Fitchburg, Mass.
Coman, James Groesbeck, I, '07 (D). Superintendent, Mexia Textile Mills, Mexia, Texas.
Conant, Harold Wright, I, '09 (D). Assistant Treasurer, United Electric Corporation, Easthampton, Mass.
Conant, Richard Goldsmith, I, '12 (D). Sales Executive, Wellington, Sears & Co., 65 Worth Street, New York City.
Conklin, Jennie Grace, IIIb, '05 (C). See Nostrand, Mrs. William L.
Connorton, John Joseph, Jr., III, '27 (D). Assistant Designer, Amoskeag Manufacturing Company, Manchester, N. H.
Cook, Kenneth Bartlett, I, '13 (D). Technical Superintendent, Winnsboro Mills, Winnsboro, S. C.
Cosendai, Edwin Frederick Ernest, IV, '15 (B.T.D.). Died November 1, 1923.
Cote, Theodore Charles, IV, '26 (B.T.C.). Research Chemist, Pacific Print Works, Lawrence, Mass.
Craig, Albert Wood, IV, '07 (D). Superintendent, Windsor Print Works, North Adams, Mass.
Craig, Clarence Eugene, III, '02 (D).
Creese, Guy Talbot, IV, '14 (D). Chemist, Creese & Cook Company, Danversport, Mass.
Crowe, Joseph Bailey, IV, '25 (B.T.C.). Textile Chemist, Procter & Gamble Co., Paterson, N. J.
Culver, Ralph Farnsworth, IV, '04 (D). Vice-President and Manager, Providence Office, Ciba Company, Inc., 61 Peck Street, Providence, R. I.
Cummings, Edward Stanton, VI, '16, (D). Industrial Engineer, with R. E. Loper & Co., Greenville, S. C.
Curran, Charles Ernest, III, '02 (C). Head Designer, Wood Worsted Mills, Lawrence, Mass.

Currier, Herbert Augustus, I ,'06 (D). Vice President, Waterman, Currier & Co., Inc., 40 Worth Street, New York City.
Currier, John Alva, II, '01 (D). Superintendent, Pentucket Mills (M.T. Stevens & Sons Company), Haverhill, Mass.
Curtis, Frank Mitchell, I, '06 (D). Retail Lumber, Wm. Curtis Sons Company, 30 Eustis Street, Roxbury, Mass.
Curtis, William Leavitt, II, '05 (C).
Cutler, Benjamin Winthrop, Jr., III, '04 (D). With Fred Butterfield & Co., Inc., 361 Broadway, New York City.
Cuttle, James H., II, '99 (D). Superintendent, S. Stroock & Co., Newburgh, N. Y.

Dalton, Gregory Smith, IV, '12 (D).
Datar, Anant Vithal, VI, '24 (B.T.E.). Inchalkaranji (S. M. Cy), India.
Davieau, Alfred Edward, VI, '16 (D). In charge of Textile Testing, United States Testing Company, Inc., 316 Hudson Street, New York City.
Davieau, Arthur Napoleon, VI, '13 (D). Superintendent, Kenwood Mills, Ltd. (F. C. Huyck & Sons), Arnprior, Ont.
Davieau, Leon Arthur, VI, '23 (B.T.E.). Assistant Designer, Aetna Mills, Watertown, Mass.
Davis, Alexander Duncan, VI, '14 (B.T.E.). Instructor, Northeastern University, Springfield, Mass.
Dearborn, Roy, VI, '13 (D). Purchasing Agent, Brightwood Manufacturing Company, North Andover, Mass.
Dearth, Elmer Elbridge, IV, '12 (D). Manager, Product Development, Fisk Rubber Company, Chicopee Falls, Mass.
Del Plaine, Parker Haywood, IV, '25 (B.T.C.). Textile Chemist, Rohm & Haas Company, Bristol, Pa.
Derby, Roland Everett, IV, '22 (B.T.C.). Dyer, Lowell Dye Works, Lowell, Mass.
de Sa, Francisco, VI, '18 (B.T.E.). Avenue da Graca, Bahia, Brazil.
Dewey, James French, II, '04 (D). Vice-President, and Superintendent, A. G. Dewey Company, Quechee, Vt.
Dewey, Maurice William, II, '11 (D). Inspector of Real Estate and Real Estate Loans, National Life Insurance Company, Montpelier, Vt.
Dillon, James Henry, III, '05 (D). Land Developing and Colonizing, 512 Summer Building, St. Petersburg, Fla.
Dods, James Barber, II, '27 (D). Vice-President and General Manager, The Dods Knitting Company, Ltd., Orangeville, Ont.
Donald, Albert Edward, II, '04 (D). 6 Griswold Court, Uxbridge, Mass.
Donovan, Joseph Richard, IV, '24 (B.T.C.). 26 Governor Winthrop Road, Somerville, Mass.
Doran, Wilbur Kirkland, II, '22 (D). Instructor, Manchester High School, Manchester, N. H.
Dorr, Clinton Lamont, VI, '14 (D). Manager, Raymond Syndicate, 356 Washington Street, Boston, Mass.
Douglas, Walter Shelton, II, '21 (D). 653 Westford Street, Lowell, Mass.
Duguid, Harry Wyatt, I, '24 (D). Office Manager, Maverick Mills, East Boston, Mass.
Dunnican, Edward Tunis, VI, '24 (B.T.E.). Second Hand, Pacific Mills, Lawrence, Mass.
Durgin, William Ernest, IV, '24 (B.T.C.). Textile Chemist, Geigy & Co., Inc., 88 Broad Street, Boston, Mass.
Duval, Joseph Edward, II, '10 (D). Yarn Agent, 308 Chestnut Street, Philadelphia, Pa.
Dwight, John Francis, Jr., II, '08 (D). Proprietor, Humarock Inn, Humarock Mass.

Echmalian, John Gregory, VI, '16 (B.T.E.). Supervisor of Training for Cheney Brothers, So. Manchester, Conn.
Ehrenfried, Jacob Benjamin, II, '07 (C). With George Ehrenfried Company, Lewiston, Me.

Elliot, Gordon Baylies, II, '12 (D). Planning Department, Pacific Mills, Lawrence, Mass.

Ellis, Charles Albert, VI, '21 (B.T.E.). With the Atmospheric Nitrogen Company, Syracuse, N. Y.

Ellis, Dorothy Myrta, VI, '25 (B.T.E.). Assistant to Employment Manager, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.

Emerson, Frank Warren, II, '03 (D). Agent, Standish Worsted Company, Penacook, N. H.

Engstrom, Karl Emil, VI, '12 (D). (S.B. 1916, Massachusetts Institute of Technology.) With Lockwood, Greene & Co., Boston, Mass.

Enloe, Winfred Paige, I, '22 (D). Assistant Superintendent, W. A. Handley Manufacturing Company, Roanoke, Ala.

Evans, Alfred Whitney, III, '03 (D).

Evans, William Robinson, III, '03 (D). 309 Main Street, Bradford, Mass.

Everett, Charles Arthur, IV, '19 (B.T.C.). Instructor, Dyeing Department, Lowell Textile School, Lowell, Mass.

Ewer, Nathaniel Trull, IV, '01 (D). Chemist, American Dyewood Company, Chester, Pa.

Fairbanks, Almonte Harrison, II, '09 (D). Treasurer and Manager, Middlesex Knitting Company, Wakefield, Mass.

Farmer, Chester Jefferson, IV, '07 (D). Professor of Chemistry, Northwestern Medical School, Chicago, Ill.

Farnsworth, Harold Vincent, VI, '16 (B.T.E.). Sales Engineer, Atkinson, Haserick & Co., 152 Congress Street, Boston, Mass.

Farr, Leonard Schaefar, II, '08 (D). Assistant Superintendent, No. 2 Mill, Farr Alpaca Company, Holyoke, Mass.

Farwell, Claude Chapman, VI, '23 (B.T.E.). Athletic Director and Head of Science Department, East Greenwich Academy, East Greenwich, R. I.

Farwell, Ray Baldwin, VI, '24, (B.T.E.). Died July 6, 1926.

Feinberg, Benjamin, II, '27 (D). Salesman, National Mill Supply Company, 184 Summer Street, Boston, Mass.

Feindel, George Paul, IV, '24 (B.T.C.). Dyer, Sayles Finishing Plant, Inc., Saylesville, R. I.

Feldstein, Martin Alexander, VI, '24 (B.T.E.). Production Manager, Amplex Instrument Laboratories, 88 West Broadway, New York City.

Fels, August Benedict, II, '99 (D).

Ferguson, Arthur Feiling, I, '03 (D). With United States Tariff Commission, Washington, D. C.

Ferguson, William Gladstone, III, '09 (D). Manager, Efficiency and Experimental Department, Ludlow Manufacturing Associates, Ludlow, Mass.

Finlay, Harry Francis, IV, '10 (D). Demonstrator, National Aniline and Chemical Company, Boston, Mass.

Fisher, Russell Todd, VI, '14 (D), '25 (B.T.E.). Secretary, National Association of Cotton Manufacturers, 80 Federal Street, Boston, Mass.

Fiske, Starr Hollinger, II, ''09 (D). Superintendent, Lowell Dye Works, Lowell, Mass.

Fitzgerald, John Francis, IV, '18 (B.T.C.). Dyer, Boston Dye House, Inc., Malden, Mass.

Fleischmann, Meyer, IV, '20 (B.T.C.). Chief Chemist, Real Silk Hosiery Mills, Indianapolis, Ind.

Fleming, Frank Everett, IV, '06 (D). Overseer, Dyeing and Finishing, Goodall Worsted Company, Sanford, Me.

Fletcher, Howard Varnum, III, '25 (D). With North Billerica Company, North Billerica, Mass.

Fletcher, Roland Hartwell, VI, '10 (D). With Pressed Steel Car Company, McKees Rocks, Pa.

Flood, Thomas Henry, IV, '27 (B.T.C.). Chemist, Bellman Brook Bleachery, Fairview, N. J.

Flynn, Thomas Patrick, IV, '11 (D). Sales Manager, E. L. Thompson Chair Corporation, Baldwinsville, Mass.

Ford, Edgar Robinson, IV, '11 (D). Chief Chemist and Superintendent of Finishing and Dyeing, Sayles Biltmore Bleacheries, Biltmore, N. C.

Forsaith, Charles Henry, VI, '20 (B.T.E.). Superintendent, Nashua Manufacturing Company (Jackson Mills), Nashua, N. H.

Forsaith, Ralph Allen, VI, '16 (B.T.E.). Assistant Superintendent, Appleton Company, Lowell, Mass.

Forsyth, Harold Downes, VI, '23 (B.T.E.). Corporation Treasurer, Wm. Forsyth & Sons Co., Lynn, Mass.

Foster, Boutwell Hyde, VI, '17 (B.T.E.). Textile Engineer, Textile Section, United States Rubber Company, 451 South Jefferson Street, Orange, N. J.

Foster, Clifford Eastman, II, '01 (D). Salesman, Wickwire Spencer Steel Company, 41 East 42nd Street, New York City.

Fowle, Edwin Daniels, VI, '24 (B.T.E.). Associate Editor, "Textile World," 65 Franklin Street, Boston, Mass.

Franks, Jerome, VI, '27 (B. T.E.). Student, Massachusetts Institute of Technology, Cambridge, Mass.

Frost, Harold Benjamin, II, '12 (D). Salesman, Liberty Mutual Insurance Company, Park Square Building, Boston, Mass.

Fuller, Allen Reed, IV, '17 (B.T.C.). Chemist, Otis Company, Three Rivers, Mass.

Fuller, George, I, '03 (D). Assistant to the President, Riverside & Dan River Cotton Mills, Inc., Danville, Va.

Gadsby, Arthur Norton, II, '13 (D). Deceased.

Gahm, George Leonhard, II, '06 (D). Superintendent, Yarn Department, Wood Worsted Mills, Lawrence, Mass.

Gainey, Francis William, IV, '11 (D). Colorist, Cheney Brothers, South Manchester, Conn.

Gale, Harry Laburton, III, '10 (D). Designer, Hunter Manufacturing and Commission Company, 58 Worth Street, New York City.

Gallagher, John Waters, II, '27 (D). 17 Robinson Avenue, Danbury, Conn.

Garlick, Mrs. Dorothy M. (Burbeck, Dorothy M.), IV, '20 (B.T.C.) Great Road, Maynard, Mass.

Gay, Olin Dow, II, '08 (D). President Gay Brothers Company, Cavendish, Vt.

Gerrish, Henry Kilborn, III, '16 (D). Died September 18, 1922.

Gerrish, Walter, III, '03 (D).

Gillie, Stanley James, I, '22 (D). Assistant Superintendent, Paterson Branch, United States Testing Company, Inc., Paterson, N. J.

Gillon, Sara Agnes, IIIb, '06 (C).

Gilman, Ernest Dana, II, '26 (D). With Pacific Mills, Lawrence, Mass.

Glickman, Bernhardt Brecher, IV, '27 (B.T.C.). Sample Dyer, Gotham Silk Hosiery Company, New York City.

Godfrey, Harold Thomas, VI, '26 (B.T.E.). With Davis & Furber Machine Co., North Andover, Mass.

Goldberg, George, VI, '10 (D). Salesman, Liberty Lace and Braid Company, 88 Bedford Street, Boston, Mass.

Goldenberg, Louis, VI, '27 (B.T.E.). Foreman and Mechanic of Knitting, Argus Knitting Mills, Lebanon, Pa.

Goldman, Moses Hyman, IV, '20 (B.T.C.). Textile Chemist, National Association Institute of Dyers and Cleaners, Inc., Silver Springs, Md.

Goller, Harold Poehlmann, II, '23 (D). Sales Department, Du Pont Rayon Company, Reading, Pa.

Goodhue, Amy Helen, IIIb, '00 (C). See Harrison, Mrs. Arthur.

Gooding, Francis Earle, IV, '19 (B.T.C.). Foreman, Calco Chemical Company, Bound Brook, N. J.

Goosetrey, Arthur, IV, '21 (B.T.C.). 14 Spring Street, Crompton, R. I.

Goosetrey, John Thomas, IV, '21 (B.T.C.). Chemist and Dyer, Rhode Island Lace Company, Inc., West Barrington, R. I.

Gould, Norman Culver, VI, '19 (B.T.E.). Textile Engineer, F. C. Huyck & Sons, Albany, N. Y.

Greenberg, Archie, II, '21 (D). 2 Ivanhoe Road, Worcester, Mass.

Greenwood, John Roger, Jr., II, '27 (D). 8 Burbank Street, Millbury, Mass.

Guild, Lawrence Winfield, VI, '27, (B.T.E.). With Lorraine Manufacturing Company, Pawtucket, R. I.

Gwinnell, George Harry, II, '25 (D). Assistant Designer, Uxbridge Worsted Company, Uxbridge, Mass.

Gyzander, Arne Kolthoff, IV, '09 (D). Chemist, Rochester Button Company, Rochester, N. Y.

Haddad, Nassib, VI, '23 (B.T.E.). With United States Rubber Company, Orange, N. J.

Hadley, Richard Francis, IV, '22 (B.T.C.). Salesman, Carbon, Coal & Coke Company, 85 Devonshire Street, Boston, Mass.

Hadley, Walter Eastman, IV, '08 (D). Chief Chemist, The Clark Thread Company, Newark, N. J.

Hadley, Wilfred Nourse, II, '22 (D). With Parks & Woolson Company, Springfield, Vt.

Hager, Hazen Otis, II, '21 (C). Manager, Firelite Natural Gas Company, Inc., Portland, Me.

Hall, Frederick Kilby, VI, '24 (B.T.E.). Assistant Cotton Technologist, United States Department of Agriculture, Clemson College, S. C.

Halsell, Elam Ryan, I, '04 (C). Assistant Superintendent, Whittenton Manufacturing Company, Taunton, Mass.

Hammond, Chester Twombly, II, '23 (D). Assistant to Wool Buyer, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.

Hanscom, Edwin Thomas, II, '27 (D). 12 Maple Street, Sanford, Me.

Hardie, Newton Gary, I, '23 (D). Superintendent, Oconee Mills Company, Westminster, S. C.

Hardy, Philip Lewis, VI, '10 (D). Contractor, Andover, Mass.

Harmon, Charles Francis, I, '99 (D).

Harrington, Thomas, IV, '15 (D). Superintendent, Monarch Leather Company, 1127 West Division Street, Chicago, Ill.

Harris, Charles Edward, I, '05 (D). Manager, Martin Fifth Wheel and Trailer Corporation, Easthampton, Mass.

Harris, George Simmons, I, '02 (C). President and General Manager, Exposition Cotton Mills, Atlanta, Ga.

Harrison, Mrs. Arthur (Goodhue, Amy Helen), IIIb, '00 (C). R. F. D. No. 2, Lowell, Mass.

Hart, Arthur Norman, IV, '19 (B.T.C.). Chemist, Crystal Analysis Company, Chicago, Ill.

Hart, Edward Roscoe, I, '23 (D). Superintendent, Victory Manufacturing Company, Fayetteville, N. C.

Haskell, Spencer Howard, II, '07 (D). Deceased.

Haskell, Walter Frank, IV, '02 (D). Overseer of Dyeing, Dana Warp Mills, Westbrook, Me.

Hassett, Paul Joseph, IV, '12 (D). Production Manager, Cortland Works, L. C. Smith & Corona Typewriters, Inc., Syracuse, N. Y.

Hathaway, William Tabor, II, '26 (D). With Percy Legge & Co., Boston, Mass.

Hathorn, George Wilmer, IV, '07 (D). Chemist, Lawrence Gas Company, Lawrence, Mass.

Hathorne, Berkeley Lewis, IV, '24 (B.T.C.). Research Chemist, Tubize Artificial Silk Company of America, Washington, D. C.

Hay, Ernest Crawford, II, '11 (D). Superintendent, Monomac Spinning Company, Lawrence, Mass.

Hendrickson, Walter Alexander, II, '11 (D). With National Knitting Company, 905 Clinton Street, Milwaukee, Wis.

Hennigan, Arthur Joseph, II, '06 (D). President, Seneca Manufacturing Company, and New England Representative, Cox & Schreiber, of New York, 225 Fourth Avenue, New York City.

Hibbard, Frederick William, IV, '25 (B.T.C.). Chemist, Appleton Company, Lowell, Mass.

Hildreth, Harold William, II, '07 (D). Granite Dealer, Westford, Mass.

Hillman, Ralph Greeley, VI, '22 (B.T.E.). Assistant Superintendent, Samson Cordage Works, Shirley, Mass.

Hindle, Milton, VI, '25 (B.T.E.). Textile Engineer, F. C. Huyck & Sons, Albany, N. Y.

Hintze, Thomas Forsyth, I, '06 (C).

Hodge, Harold Bradley, VI, '22 (B.T.E.). Chief Engineer, J. C. and W. T. Monahan, Civil Engineers and Surveyors, 219 Central Street, Lowell, Mass.

Hoffman, Richard Robert, II, '21 (C). Assistant Designer, Beoli Mills, Fitchburg, Mass.

Holden, Francis Crawford, IV, '09 (D). Chemist, Chelsea Fibre Mills, 1155 Manhattan Avenue, Brooklyn, N. Y.

Holden, John Sanford, II, '20 (D). Manufacturer, Automatic Machine Products' Company, Attleboro, Mass.

Holgate, Benjamin, III, '02 (C). Agent, Boott Mills, Lowell, Mass.

Hollings, James Louis, I, '05 (D). Buyer and Converter (Cotton Goods), W. R. Grace & Co., 7 Hanover Square, New York City.

Hollstein, William Diedrick, VI, '25 (B.T.E.). Sales Department, Schwarzenbach, Huber & Co., New York City.

Holmes, Otis Milton, VI, '13 (B.T.E.). Draftsman, United Shoe Machinery Corporation, Beverly, Mass.

Hood, Leslie Newton, IV, '12 (D). Chemist, Union Bleachery, Greenville, S. C.

Hook, Russell Weeks, IV, '05 (D). Chemist in charge of Textile Department, Arthur D. Little, Inc., 30 Charles River Road, Cambridge, Mass.

Hooper, Clarence, IV, '27 (B.T.C.). Overseer of Dyeing, Waynesboro Knitting Company, Waynesboro, Pa.

Horne, James Albert, I, '24 (D). Mill Department, Wellington, Sears & Co., 93 Franklin Street, Boston, Mass.

Horsfall, George Gordon, II, '04 (C). Assistant Dyer, Interwoven Mills, Inc., Martinsburg, W. Va

Horton, Chester Temple, VI, '14 (B.T.E.). Wilmington, Mass.

Houghton, Robert Kingsbury, IV, '23 (B.T.C.). Dyer, Sayles Finishing Plants, Inc., Saylesville, R. I.

Howarth, Charles Lincoln, IV, '17 (B.T.C.). Assistant Professor of Dyeing, Lowell Textile School, Lowell, Mass.

Howe, Woodbury Kendall, I, '10 (D). Assistant Superintendent, Merrimack Manufacturing Company, Lowell, Mass.

Hoyt, Charles William Henry, IV, '07 (D).

Hsu, Hsueh-Chang, VI, '23 (B.T.E.).

Hubbard, Harold Harper, I, '22 (D). With National Association of Cotton Manufacturers, 80 Federal Street, Boston, Mass.

Hubbard, Ralph King, IV, '11 (D). Treasurer and Manager, Packard Mills Inc., Webster, Mass.

Huising, Gerónimo Huerva, I, '08 (D). Farmer, Hda "Perseverancia," San José, Mindoro, P. I.

Hunt, Chester Lansing, III, '05 (C).

Hunton, John Horace, II, '11 (D). Treasurer, Newichawanick Company, South Berwick, Me.

Hurtado, Leopoldo, Jr., VI, '10 (D). General Manager, Hurtado & Co., Uruapan, Michoacán, Mex.

Hurwitz, Jacob, IV, '23 (B.T.C.).

Hutton, Clarence, III, '03 (C). Editor, "Textile World," 65 Franklin Street, Boston, Mass.

Irvine, James Andrew, VI, '17 (B.T.E.). Manager of Employment and Training, Cheney Brothers, South Manchester, Conn.

Isaacson, George Franklin, II, '26 (D). Assistant Designer, Hoosac Cotton Mills, North Adams, Mass.

Jaeger, Robert William, Jr., IV, '23 (B.T.C.). In Research Laboratory, Armour & Co., Chicago, Ill.

Finishing Department

Jelleme, William Oscar, I, '10 (D). With Pacific Mills, 24 Thomas Street, New York City.
Jen, Shang Wu, I, '21 (D).
Jenckes, Leland Aldrich, VI, '08 (D). Deceased.
Jessop, Charles Clifford, VI, '22 (B.T.E.). Development Engineer, Crex Carpet Company, St. Paul, Minn.
Johnson, Arthur Kimball, IV, '13 (D), (S.B. 1917 Massachusetts Institute of Technology). Instructor in Chemistry, Lowell Textile School, Lowell, Mass.
Johnson, George Henry, IV, '20 (B.T.C.). Director of Research, Laundry Owners National Association, Mellon Institute, Pittsburgh, Pa.
Johnson, Philip Stanley, IV, '24 (B.T.C.). Color Chemist and Sales Manager, Tizian Color Company, 25 Arch Street, Boston, Mass.
Jones, Everett Amos, III, '05 (D). Superintendent and Assistant Secretary, Nye & Wait Kilmarnock Corporation, Auburn, N. Y.
Jones, Nathaniel Erskine, I, '21 (D). Instructor, Cotton Yarns and Knitting, Lowell Textile School, Lowell, Mass.
Joy, Thomas, VI, '26 (B.T.E.). Engineer, Cambridge Rubber Company, Cambridge, Mass.
Jury, Alfred Elmer, IV, '04 (D). Manager, Textile Development, United States Rubber Company, 1790 Broadway, New York City.

Kaatze, Julius, VI, '22 (B.T.E.). Salesman, Toledo Scale Company, Lawrence, Mass.
Kao, Chieh-Ching, VI, '23 (B.T.E.).
Karanfilian, John Hagop, VI, '21 (B.T.E). 5508 Chester Avenue, West Philadelphia, Pa.
Kay, Harry Pearson, II, '09 (D). Associate Member, Stanford Wright Agency, Pennsylvania Mutual Life Insurance Company, Boston, Mass.
Kendall, Charles Henry, II, '23 (D). Superintendent, Bridgewater Woolen Company, Bridgewater, Vt.
Kennedy, Francis Charles, VI, '26 (B.T.E.). Fabric Development, The Fisk Rubber Company, Chicopee Falls, Mass.
Kenney, Frederick Leo, II, '27 (D). Assistant Designer, Uxbridge Worsted Company, Uxbridge, Mass.
Kent, Clarence LeBaron, III, '06 (C). Agent, Standard Oil Company, Rochester, N. H.
Keough, Wesley Lincoln, II, '10 (D). With E. A. Pierce & Co., Pasadena, Calif.
Kingsbury, Percey Fox, IV, '01 (D). Print Manager, Passaic Print Works, Passaic, N. J.
Knowland, Daniel Power, IV, '07 (D). Chemist, Geigy Company, Inc., 89 Barclay Street, New York City.
Knox, Joseph Carleton, VI, '23 (B.T.E.). Assistant Sanitary Engineer, State Department of Health, Boston, Mass.
Kuo, Limao, VI, '26 (B.T.E.).

Lakeman, Fannie Shillaber, IIIb, '00 (C). Died February 8, 1921.
Lamb, Arthur Franklin, II, '10 (D). Rockland, Me.
Lamont, Robert Laurence, II, '12 (D).
Lamprey, Leslie Balch, IV, '16 (B.T.D.). 173 Parker Street, Lawrence, Mass.
Lamson, George Francis, I, '00 (D). With Ludlow Manufacturing Associates, Ludlow, Mass.
Lane, John Williams, I, '06 (C).
Lane, Oliver Fellows, IV, '15 (B.T.D.). Chemist, Head of Color Making Department, Lowe Paper Company, Ridgefield, N. J.
Larratt, John Francis, II, '22 (D). With Mohawk Carpet Company, Amsterdam, N. Y.
Laughlin, James Knowlton, III, '09 (D).
Laurin, Eric Thursten Lawrence, IV, '21 (B.T.C.). Superintendent of Dyeing, Bradford Dyeing Association, Bradford, R. I.

Laurin, Sven Albert, IV, '23 (B.T.C.). Assistant Dyer, Slatersville Finishing Company, Slatersville, R. I.
Leach, John Pelopidas, I, '00 (C). Farming, Littleton, N. C.
Leavitt, George Herbert, II, '26 (D). Foreman of Yarn Inspection, F. C. Huyck & Sons, Albany, N. Y.
Lee, William Henry, II, '05 (C). Manager, Graves Hall & Co., Inc., New Haven, Conn.
Leitch, Harold Watson, IV, '14 (B.T.D.). Chemical Engineer, M. T. Stevens & Sons Co., Franklin, N. H.
Lemire, Joseph Emile, VI, '21 (B.T.E.). In Real Estate Business, Lowell, Mass.
Leonard, Leo Edward, I, '27 (D). 115 West Street, Worcester, Mass.
Levi, Alfred Sandel, IV, '09 (D). Vice-President, Liondale Bleach, Dye and Print Works, Rockaway, N. J.
Lewis, George Kenneth, VI, '24 (B.T.E.). Overseer, Jackson Mills (Nashua Manufacturing Company), Nashua, N. H.
Lewis, LeRoy Clark, IV, '08 (D). Representative, David T. Jones, Inc., 185 Madison Avenue, New York City.
Lewis, Walter Scott, IV, '05 (D). Special Expert in Textiles, United States Tariff Commission, Washington, D. C.
Lillis, Marvin Hale, IV, '14 (D). With Marland Mills, Andover, Mass.
Linsey, Edward, II, '25 (D). Production Department, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.
Lombard, Carleton Joshua, VI, '23 (B.T.E.). With Curtis & Marble Machine Company, Worcester, Mass.
Loney, Robert William, II, '22 (D). Foreman, General Electric Company, Schenectady, N. Y.
Longbottom, Parker Wyman, IV, '21 (B.T.C.). Chemist, National Aniline & Chemical Company, 28 Lewis Wharf, Boston, Mass.
Lowe, Philip Russell, VI, '24 (B.T.E.). Plant Engineer, Smith & Dove Manufacturing Company, Andover, Mass.
Lucey, Edmund Ambrose, II, '04 (D). President, Wm. A. Tottle & Co., Inc., Baltimore, Md.
Lussier, Joseph Adrien, II, '27 (D). 183 Park Avenue, Woonsocket, R. I.

McCann, John Joseph, Jr., VI, '24 (B.T.E.).
McCool, Frank Leslie, IV, '10 (D). Vice-President, S. R. David & Co., Inc., 252 Congress Street, Boston, Mass.
Macdonald, Hector Graham, IV, '19 (B.T.C.). Superintendent of Dyeing, Franklin Rayon Dyeing Company, Providence, R. I.
McDonnell, William Henry, I, '06 (C). Lawyer, McDonnell & White, 40 Court Street, Boston, Mass.
McGowan, Frank Robert, VI, '15 (B.T.E.). Textile Engineering Advisor, Cotton-Textile Institute, Inc., 320 Broadway, New York City.
McGowan, Henry Earl, VI, '22 (B.T.E.). Instructor, Lowell High School, Lowell, Mass.
Mackay, Stewart, III, '07 (D). Assistant Professor of Textile Design, Lowell Textile School, Lowell, Mass.
McKenna, Hugh Francis, IV, '05 (D). Chicago Manager, United Indigo and Chemical Company, Ltd., 218 West Kinzie Street, Chicago, Ill.
McKinstry, James Bradley, II, '25 (D). Superintendent, Ottaquechee Woolen Company, Evarts, Vt.
MacPherson, Wallace Angus, III, '04 (D). Designer, Wuskanut Mills, Inc. (S. Slater & Sons), Farnumsville, Mass.
Macher, Henry, II, '23 (D). Industrial Research Work, Botany Worsted Mills, Passaic, N. J.
Mahoney, George Stephen, VI, '22 (B.T.E.). Overseer, Franklin Cotton Mill Company, Cincinnati, Ohio.
Mailey, Howard Twisden, II, '08 (D). Assistant Superintendent, Worsted Department, Pacific Mills, Lawrence, Mass.
Manning, Frederick David, IV, '10 (D). Planning Department, Pacific Mills, Lawrence, Mass.

Marinel, Walter Newton, I, '01 (D). Automobile Repairing, North Chelmsford, Mass.

Mark, Aris Sawa, VI, '22 (B.T.E.). Sales Department, Overton Textile Company, New York City.

Marshall, Chester Stanley, II, '22 (D.) Salesman, Dupont Rayon Company, 31 North 6th Street, Reading, Pa.

Martin, Harry Warren, IV, '11 (D). Assistant Footwear Superintendent, Hood Rubber Company, Watertown, Mass.

Mason, Archibald Lee, VI, '09 (D). With Merrimack Woolen Company, Dracut, Mass.

Mason, Philip Edwin, IV, '26 (B.T.C.). Salesman and Chemist, Watson Park Company, 470 Atlantic Avenue, Boston, Mass.

Mather, Harold Thomas, VI, '13 (D). Inspector, Associated Factory Mutual Fire Insurance Companies, Boston, Mass.

Mathieu, Alfred Jules, II, '20 (D). Superintendent of Combing, French Worsted Company, Woonsocket, R. I.

Matthews, Elmer Clark, II, '17 (D). Superintendent, Thermo Mills, Inc., West Sand Lake, N. Y.

Mauersberger, Herbert Richard Carl, III, '18 (D). Chief Assistant with James W. Cox, Jr., Textile Engineer, 320 Broadway, New York City.

Mazer, Samuel, IV, '26 (B.T.C.). In business, Wilber Skein Dyeing Company, Hyde Park, Mass.

Meadows, William Ransom, I, '04 (D). Cotton Registrar, Chicago Board of Trade, Chicago, Ill.

Meek, Lotta, IIIb, '07 (C). See Parker, Mrs. Herbert L.

Meeker, Samuel, IV, '27 (B.T.C.). Textile Chemist, Procter & Gamble Co., Paterson, N. J.

Merchant, Edith Clara, IIIb, '00 (C). Art Supervisor, Lowell, Mass.

Merrill, Allan Blanchard, IV, '11 (D). Development Engineer, B. F. Goodrich Rubber Company, Akron, Ohio.

Merrill, Gilbert Roscoe, VI, '19 (B.T.E.). Professor of Textiles; in charge of Cotton Yarn Department, Lowell Textile School, Lowell, Mass.

Merrill, John Leslie, VI, '27 (B.T.E.). Instructor in Weaving, Lowell Textile School, Lowell, Mass.

Merriman, Earl Cushing, II, '07 (D). Died September 30, 1918.

Meyers, Chester William, IV, '27 (B.T.C.). Billerica, Mass.

Midwood, Arnold Joseph, IV, '05 (D). Salesman, Dyestuffs Corporation of America, 281 Franklin Street, Boston, Mass.

Miller, Joshua, VI, '24 (B.T.E.). Assistant Technologist, Bureau of Standards, Washington, D. C.

Minge, Jackson Chadwick, I, '01 (C).

Mirsky, Leon Robert, II, '19 (D). Salesman, New York Machinery Company, New York City.

Mitchell, Charles Alvah, II, '24 (D). Production Department, Mohawk Carpet Mills, Inc., Amsterdam, N. Y.

Moller, Ernest Arthur, II, '22 (D). Assistant Sales Manager, The Flintkote Company, 809 Park Square Building, Boston, Mass.

Molloy, Francis Henry, II, '16 (D). Assistant Designer, Assabet Mill (American Woolen Company), Maynard, Mass.

Moore, Edward Francis, II, '25 (D). Assistant Superintendent, Worsted Department, Rockford Mitten and Hosiery Company, Rockford, Ill.

Moore, Everett Byron, I, '05 (D). President, Chadbourne & Moore, Inc., Chelsea, Mass.

Moore, Karl Remick, IV, '11 (D). Chemical Engineer, Stillwater Worsted Mills, Harrisville, R. I.

Moore, William Joseph, IV, '21 (B.T.C.). Chemist, Pacific Mills, Lawrence, Mass.

Moorhouse, William Roy, IV, '01 (D). Domestic Sales Manager, National Aniline and Chemical Company, Inc., 40 Rector Street, New York City.

Morrill, Howard Andrew, VI, '16 (D). 116 North Street, Saco, Me.

Morris, Merrill George, IV, '21 (B.T.C.). Overseer of Dyeing, Joseph Wild & Co. (Nassau Felt Mills), Brooklyn, N. Y.
Morrison, Fred Clifton, I, '03 (D). Died August 21, 1919.
Morrison, Haven Asa, IV, '25 (B.T.C.). Chemist, The Barre Wool Combing Company, Ltd., 300 Summer Street, Boston, Mass.
Mullaney, John Francis, VI, '20 (B.T.E.). Salesman Saco-Lowell Shops, Newton Upper Falls, Mass.
Mullen, Arthur Thomas, II, '09 (D). 58 Butler Street, Lawrence, Mass.
Munroe, Sydney Philip, I, '12 (D). Manager, Ralph E. Loper & Co., Greenville, S. C.
Murray, James, IV, '13 (D). Chief Chemist, Appleton Coated Paper Company, Appleton, Wis.
Murray, James Andrew, II, '10 (D). Treasurer, Murray-Sinclair Company, Inc., 144 Commercial Street, Boston, Mass.

Najar, G. George, IV, '03 (D). Overseer of Dyeing, Monument Mills, Housatonic, Mass.
Nary, James Anthony, II, '22 (D). Manager, Chicago Testing House, United States Testing Company, Inc., Chicago, Ill.
Nelson, Roy Clayton, II, '21 (C). Designer, Assabet Mills, Maynard, Mass.
Nelson, Russell Sprague, VI, '22 (B.T.E.). Cost Department, Draper Corporation, Hopedale, Mass.
Neugroschl, Sigmond Israel, I, '21 (D).
Newall, John Douglas, IV, '09 (D). Divisional Superintendent, Arnold Print Works, North Adams, Mass.
Newcomb, Guy Houghton, IV, '06 (C). Assistant Director of Sales, E. I. du Pont de Nemours & Co., 9132 du Pont Building, Wilmington, Del.
Neyman, Julius Ellis, IV, '15 (B.T.D.). Furniture Dealer, Neyman Furniture Company, 197-199 Middlesex Street, Lowell, Mass.
Nichols, Raymond Elmore, VI, '10 (D). Chief Draftsman, H. E. Fletcher Company, West Chelmsford, Mass.
Niven, Robert Scott, VI, '12 (D). Turbine Drafting Department, General Electric Company, Lynn, Mass.
Nostrand, Mrs. William L. (Conklin, Jennie Grace), IIIb, '05 (C). 35 87th Street, Bay Ridge, Brooklyn, N. Y.

O'Brien, Philip Francis, II, '15 (D), (B.S. New York University). Head of Textile Department, New York Textile High School, New York City.
O'Connell, Clarence Edward, IV, '11 (D). Dyer, National Aniline and Chemical Company, Buffalo, N. Y.
O'Connor, Lawrence Dennis, VI, '17 (D). With Beggs & Cobb, Winchester, Mass.
O'Donnell, John Delaney, I, '04 (C).
O'Hara, William Francis, IV, '04 (C). Superintendent, National Oil Products Company, Harrison, N. J.
Olson, Carl Oscar, II, '24 (D). 741 Broadway, West Somerville, Mass.
Orr, Andrew Stewart, IV, '22 (B.T.C.). With Cherry & Webb, Lowell, Mass.
Othote, Louis Joseph, I, '23 (D). Designer and Styler, T. Holt Haywood, 65 Leonard Street, New York City.

Palais, Samuel, IV, '18 (B.T.C.). Assistant Manager, Durrel Company, 1 Beacon Street, Boston, Mass.
Parker, B. Moore, I, '01 (D). Died December 11, 1918.
Parker, Everett Nichols, I, '05 (D). President, Parker Spool and Bobbin Company, 27-53 Middle Street, Lewiston, Me.
Parker, Harry Carmi, III, '00 (C). 142 Berkeley Street, Boston, Mass.
Parker, Mrs. Herbert L. (Meek, Lotta L.), IIIb, '07 (C). 4 Brookside Circle, Auburn, Me.
Parker, Hubert Frederic, VI, '20 (B.T.E.). Assistant to Engineer, Castanea Paper Company, Lock Haven, Pa.

Parkin, Robert Wilson, VI, '27 (B.T.E.). Office Manager and Cost Accountant, Limerick Mills, Limerick, Me.

Parkis, William Lawton, I, '09 (D). Assistant Superintendent, Cheney Brothers, South Manchester, Conn.

Parsons, Charles Sumner, VI, '27 (B.T.E). With Pepperell Manufacturing Company, Lowell, Mass.

Peabody, Roger Merrill, II, '16 (D). Textile Superintendent, Industrial Fiber Company, Cleveland, Ohio.

Pearson, Alfred Henry, IV, '11 (D). Salesman, Ciba Company, Inc., 93 Broad Street, Boston, Mass.

Pease, Chester Chapin, I, '09 (D). Agent, Columbian Mills (Otis Company), Greenville, N. H.

Peck, Carroll Wilmot, IV, '13 (D). Vice-President, George Mann & Co., Inc., Providence, R. I.

Pensel, George Robert, IV, '13 (B.T.D.). Vice-President, Ritter Chemical Company, Inc., Amsterdam, N. Y.

Perkins, John Edward, III, '00 (D). Superintendent, S. N. & C. Russell Manufacturing Company, Pittsfield, Mass.

Perkins, Joshua Dean, III, '08 (D). Overseer, Amoskeag Manufacturing Company, Manchester, N. H.

Perlman, Samuel, IV, '17 (B.T.C.).

Perlmuter, Barney Harold, IV, '23 (B.T.C.). Credit Manager, American Furniture Company, Boston, Mass.

Petty, George Edward, I, '03 (C). With Jefferson Standard Insurance Company, Greensboro, N. C.

Phaneuf, Maurice Philippe, III, '20 (D). Estimator and Draftsman, S. Belanger & Sons, Inc., Nashua, N. H.

Pierce, George Whitwell, IV, '25 (B.T.C.). Overseer of Dyeing, American Cellulose and Chemical Company, Cumberland, Md.

Pillsbury, Ray Charles, I, '13 (D). Superintendent of Weaving, Cheney Brothers, South Manchester, Conn.

Plaisted, Webster E., II, '18 (D). Superintendent, John and James Dobson, Inc., Philadelphia, Pa.

Plummer, Elliot Barton, IV, '13 (D). Died January 14, 1919.

Potter, Carl Howard, I, '09 (D). Resident Manager, Green River Manufacturing Company, Tuxedo, N. C.

Pottinger, James Gilbert, II, '12 (D). Piece Goods Buyer, Reliance Manufacturing Company, 212 West Monroe Street, Chicago, Ill.

Powers, Walter Wellington, IV, '20 (B.T.C.). Color Chemist, Fiberloid Corporation, Indian Orchard, Mass.

Pradel, Alois Joseph, III, '00 (D). Designer, Killingly Worsted Company, Danielson, Conn.

Pradel, Mrs. Alois J. (Walker, Anna G.), IIIb, '03 (C). 78 Broad Street, Danielson, Conn.

Precourt, Joseph Octave, VI, '21 (B.T.E.). Western Sales Manager, Cayuga Linen and Cotton Mills, Inc., 437 West Ontario Street, Chicago, Ill.

Prescott, Walker Flanders, IV, '09 (D). Manager, Prescott & Co., Reg'd, 326 St. James Street, Montreal, Can.

Prince, Sylvanus Cushing, VI, '08 (D).

Proctor, Braman, IV, '08 (D). With General Dyestuff Corporation, 159 High Street, Boston, Mass.

Putnam, George Ives, IV, '16 (B.T.D.). Chief Chemist, McLoughlin Textile Corporation, Utica, N. Y.

Putnam, Leverett Nelson, IV, '10 (D). Overseer of Dyeing, Arlington Mills, Lawrence, Mass.

Putnam, Philip Clayton, IV, '13 (D). Foreman Dyer, Apponaug Company, Apponaug, R. I.

Quinlan, William Harold, VI, '20 (B.T.E.). Research Assistant, Warren Brothers Company, 38 Charles River Road, Cambridge, Mass.

Radford, Garland, II, '20 (D). Manufacturer, Oriental Textile Mills, Houston, Tex.

Ramsdell, Theodore Ellis, I, '02 (D). Agent, Monument Mills, Housatonic, Mass.

Rasche, William August, III, '03 (D). Deceased.

Raymond, Charles Abel, IV, '07 (D). Superintendent, New England Fuel and Transportation Co., Everett, Mass.

Redding, Leslie Capron, II, '26 (D). Assistant Designer, Saranac Mills, Blackstone, Mass.

Reed, Norman Bagnell, I, '10 (D). President and Treasurer, Lowell Mills Company, Lowell, Mass.

Reynolds, Fred Bartlett II, '08 (D). Purchasing Agent, M. T. Stevens & Sons Company, North Andover, Mass.

Reynolds, Isabel Halliday, III, '03 (C). Clerk, Pacific Mills Print Works, Lawrence, Mass.

Reynolds, Raymond, II, '24 (D). With Silesia Mills, North Chelmsford, Mass.

Rice, Josiah Alfred, Jr., III, '20 (D). Assistant Manager, Wholesale Ginghams & Wool Goods, Marshall Field & Co., Chicago, Ill.

Rich, Edward, IV, '15 (B.T.D.). Merchant, Jackson Caldwell Company, East Boston, Mass.

Rich, Everett Blaine, III, '11 (D). Onacove-Sewall Road, Wolfboro, N. H.

Rich, Milton Scott, II, '22 (D). With Riverina Mills, Medford Hillside, Mass.

Richardson, George Oliver, IV, '16 (B.T.D.). Manager, Tientsin Office, National Aniline and Chemical Company, U. S. A., Tientsin, China.

Richardson, Richardson Perry, I, '13 (D). Salesman, H. F. Livermore Company, Boston, Mass.

Riggs, Homer Chase, VI, '17 (B.T.E.). Sales Engineer, Rodney Hunt Machine Company, Orange, Mass.

Ripley, George Keyes, II, '17 (D). Superintendent, Troy Blanket Mills, Troy, N. H.

Rivers, William Anthony, II, '24 (D). Superintendent, Nantanna Worsted Company, Northfield, Vt.

Roberson, Pat Howell, I, '05 (C). Merchant, James R. Roberson & Sons, Cropwell, Ala.

Roberts, Carrie Isabel, IIIb, '05 (C). Craft Work, 37 Grace Street, Lowell, Mass.

Robinson, Ernest Warren, IV, '08 (D). Silk Department Manager, J. & P. Coats, Inc., Pawtucket, R. I.

Robinson, Russell, VI, '21 (B.T.E.). Assistant Textile Superintendent, Celanese Corporation of America, Amcelle, Md.

Robinson, William Albert, II, '25 (D). Planning Department, Chelsea Fibre Mills, 1155 Manhattan Avenue, Brooklyn, N. Y.

Robinson, William Carleton, III, '03 (C). With American Wool and Cotton Reporter, 530 Atlantic Avenue, Boston, Mass.

Robson, Frederick William Charles, IV, '10 (D).

Roche, Raymond Vincent, IV, '12 (D). Died September 10, 1926.

Royal, Louis Merry, VI, '21 (B.T.E.). Principal, Charlemont High School, Charlemont, Mass.

Rundlett, Arnold Dearborn, VI, '12 (D). Superintendent, Joseph Noone's Sons Company, Peterborough, N. H.

Runnells, Harold Nelson, IV, '25 (B.T.C.). Textile Chemist, Thermo Mills, Inc., West Sand Lake, N. Y.

Russell, John William, IV, '20 (B.T.C.). Superintendent, Lawrence Dye Works, United States Worsted Corporation, Lawrence, Mass.

Ryan, David Louis, II, '27 (D). District Sales Representative, American Glanzstoff Corporation, Paterson, N. J.

Ryan, Lawrence Francis, IV, '23 (B.T.C.). Chemist, Pacific Mills, Lawrence, Mass.

Ryan, Millard Kenneth Thomas, Jr., II, '24 (D). Textile Engineer, United States Testing Company, Inc., 316 Hudson Street, New York City.

Sanborn, Frank Morrison, VI, '19 (B.T.E.).
Sanborn, Ralph Lyford, VI, '16 (B.T.E.). With Manville Jenckes Company, Gastonia, N. C.
Sandlund, Carl Seth, VI, '25 (B.T.E.). Research Department, McCallum Silk Hosiery Company, Northampton, Mass.
Sargent, Robert Edward, IV, '25 (B.T.C.). With Bradford Dyeing Association, Bradford, R. I.
Sargent, Walter Ambrose, I, '22 (D). Instructor, Textile Shop Practice, Public Schools, Passaic, N. J.
Saunders, Harold Fairbairn, IV, '09 (D). Superintendent, Lithopone Department, Sherwin Williams Company, Chicago, Ill.
Savery, James Bryan, II, '23 (D). In Designing Department, Berkshire Woolen Company, Pittsfield, Mass.
Sawyer, Joseph Warren, IV, '15 (B.T.D.). Died May 6, 1926.
Sawyer, Richard Morey, VI, '27 (B.T.E.). Student, Massachusetts Institute of Technology, Cambridge, Mass.
Scanlon, Andrew Augustine, IV, '26 (B.T.C.).
Schaetzel, André Paul, IV, '21 (B.T.C.). Chemist, Uhlig Piece Dye Works, Haledon, N. J.
Schneiderman, Jacob, III, '27 (D). Radio Salesman and Expert, "The Radio Shack," 16-19 Brattle Street, Boston, Mass.
Schreiter, Ehrich Ernest Max, VI, '26 (B.T.E.). Technical Department, W. R. Grace & Co., 7 Hanover Square, New York City.
Schwarz, Herman Louis, IV, '22 (B.T.C.). With Ciba Company, Inc., New York City.
Scott, Gordon Maxwell, IV, '20 (B.T.C.). Chemist, Holden-Leonard Company, Bennington, Vt.
Shaber, Hyman Jesse, VI, '17 (B.T.E.). 35 Factory Street, Nashua, N. H.
Shanahan, James Edward, II, '22 (D). With Stephen Sanford & Sons, Amsterdam, N. Y.
Shananquet, Mrs. Lee (Woodies, Ida A.), IIIb, '00 (C). Occupational Therapist, Sunshine Sanatorium, Grand Rapids, Mich.
Shea, Francis James, II, '12 (D). Clerk, Corticelli Silk Company, Florence, Mass.
Shenker, Nahman, III, '25 (D).
Sidebottom, Leon William, IV, '11 (D). Colorist, General Dyestuff Corporation, 159 High Street, Boston, Mass.
Sjostrom, Carl Gustof Verner, Jr., III, '17 (D). Designer, Virginia Woolen Company, Winchester, Va.
Slamin, Alfred Francis, I, '26 (D). With Nashua Manufacturing Company, (Suffolk Mills), Lowell, Mass.
Sleeper, Robert Reid, IV, '00 (D). Textile Colorist, Calco Chemical Company, Bound Brook, N. J.
Smith, Albert Adams, I, '99 (D). Deceased.
Smith, Allen Batterman, I, '26 (D). Assistant Superintendent, Maverick Mills, East Boston, Mass.
Smith, Doane White, II, '10 (D). 15 Oakland Street, Natick, Mass.
Smith, Frank Kenfield, II, '24 (D). Textile Testing, United States Testing Company, Inc., Paterson, N. J.
Smith, Herbert Jeffers, VI, '22 (B.T.E.). Overseer of Ring Spinning, Potter Fine Spinners, Inc., Pawtucket, R. I.
Smith, Ralston Fox, I, '04 (C). Sales Manager, W. H. Warner & Co., 1708 Union Trust Building, Cleveland, Ohio.
Smith, Roger Dennis, II, '27 (D). 131 Portland Street, Haverhill, Mass.
Smith, Stephen Eaton, I, '00 (D). Died May 10, 1926.
Smith, Theophilus Gilman, Jr., IV, '10 (D). Farming, Groton, Mass.
Smith, William Charles, IV, '26 (B.T.C.). Research Associate, American Associate of Textile Chemists & Colorists, Bureau of Standards, Washington, D. C.
Snelling, Fred Newman, II, '03 (D). With the American Railway Express Company, Haverhill, Mass.

Sokolsky, Henry, VI, '17 (B.T.E.). Industrial Engineer, B. F. Sturtevant Company, Hyde Park, Mass.

Somers, Benjamin, II, '25, (D). Wool Broker and Dealer, 184 Summer Street, Boston, Mass.

Southwick, Charles Hudson, IV, '22 (B.T.C.). Boss Dyer, Fairmount Dye Works, Woonsocket, R. I.

Spiegel, Edward, II, '03 (C). Theatrical Business, New York City.

Standish, John Carver, IV, '11 (D). Superintendent, Albany Felt Company, Albany, N. Y.

Stass, John George, II, '27 (D). Assistant Styler, Amory, Browne & Co., 64 Worth Street, New York City.

Steele, Everette Vernon, IV, '24 (B.T.C.). Sales Representative, Rohm & Haas Co., Philadelphia, Pa.

Stevens, Dexter, I, '04 (D). Manager, Esmond Mills, Esmond, R. I.

Stevens, Raymond Russell, IV, '19 (B.T.C.). Overseer of Dyeing, The Felters Company, Inc., Millbury, Mass.

Stevenson, Murray Reid, III, '03 (C).

Stewart, Arthur Andrew, II, '00 (D). Professor of Textiles; in charge of Finishing Department, Lowell Textile School, Lowell, Mass.

Stewart, Walter Lawrence, III, '03 (D).

Stiegler, Harold Winfred, IV, '18 (B.T.C.), (M.S. 1922, Ph.D. 1924, Northwestern University). Research Work, Cheney Brothers, So. Manchester, Conn.

Stohn, Alexander Charles, III, '06 (C). General Superintendent, Carl Stohn, Inc., Hyde Park, Mass.

Stone, Ira Aaron, IV, '09 (D). Vice-President, Royal Manufacturing Company, 115 Federal Street, Boston, Mass.

Storer, Francis Everett, II, '07 (D). With Windham County National Bank, Danielson, Conn.

Stronach, Irving Nichols, IV, '10 (D). With Hampton Company, Easthampton, Mass.

Stursberg, Paul William, II, '07 (D). Died in 1913.

Sturtevant, Albert William, IV, '17 (D). Mechanic, Pitts Motor Sales, 53 Hurd Street, Lowell, Mass.

Sturtevant, Fred William, IV, '26 (B.T.C.). Chemist, Watson Park Company, 470 Atlantic Avenue, Boston, Mass.

Suhlke, Waldo Eric, IV, '20 (B.T.C.). 7 Banks Street, Waltham, Mass.

Sullivan, John David, VI, '12 (D). With Robert Gair Company, Bradford, Mass.

Sullivan, Lambert William, II, '23 (D). Main Street, Groton, Mass.

Sullivan, Willard David, II, '23 (D). 39 Loring Street, Lowell, Mass.

Sunbury, Herbert Ellsworth, VI, '18 (B.T.E.). Mill Manager, Asbestos Spinning & Weaving Corporation, Waterford, N. Y.

Sutcliffe, Henry Mundell, II, '25 (D). With Uxbridge Worsted Company, Uxbridge, Mass.

Sutton, Leslie Emans, I, '17 (D). Superintendent, Anniston Cordage Company, Anniston, Ala.

Swain, Harry LeRoy, Jr., I, '26 (D). Associate in Research Laboratory, Firestone Tire & Rubber Co., Akron, Ohio.

Swan, Guy Carleton, II, '06 (D). Chemist in charge of Imports, United States Department of Agriculture, 641 Washington Street, New York City.

Sweeney, George Hamilton, II, '24 (D). Salesman, Walker Stetson Company, 157 Essex Street, Boston, Mass.

Sweet, Arthur Dutcher, VI, '21 (B.T.E.). Died January 27, 1927.

Swift, Edward Spooner, S. J., I, '02 (D). Clergyman, Church of the Immaculate Conception, Boston, Mass.

Sylvain, Charles Emile, VI, '13 (D). Resident Engineer, Saco-Lowell Shops, and Textile Engineer for International Machinery Company, Rua S. Pedro, 66, Rio de Janeiro, Brazil.

Syme, James Francis, II, '00 (D). With Mohawk Carpet Mills, Inc., Amsterdam, N. Y.

Symmes, Dean Whiting, IV, '22 (B.T.C.). Chemist and Demonstrator, National Aniline and Chemical Company, 27 Lewis Wharf, Boston, Mass.

Tarpey, Thomas Joseph, IV, '27 (B.T.C.). Textile Chemist, Procter & Gamble, Cincinnati, Ohio.

Teague, Charles Baird, II, '26 (D). With Pacific Mills, Lawrence, Mass.

Thaxter, Joseph Blake, Jr., II, '12 (D). With Smith & Dove Manufacturing Company, Andover, Mass.

Thomas, Roland Vincent, I, '05 (C).

Thompson, Arthur Robert, Jr., IV, '22 (B.T.C.). Southern Manager, Rohm & Haas Company, Inc., 1109 Independence Building, Charlotte, N. C.

Thompson, Everett Leander, I, '05 (D). Salesman, Gulf Refining Company, Brockton, Mass.

Thompson, Henry James, IV, '00 (D). Dyer, United States Rubber Company, Malden, Mass.

Tilton, Elliott Thorp, II, '99 (D). Died January, 1917.

Todd, Walter Ernest, III, '23 (D). Night Superintendent, Stanley Woolen Company, Uxbridge, Mass.

Toepler, Carl, IV, '22 (B.T.C.). Plant Chemist, Bellman Brook Bleachery Co., Fairview, N. J.

Toovey, Sidney Ernest, II, '04 (C). Deceased.

Toshach, Reginald Alexander, II, '11 (D). Assistant Superintendent, M. T. Stevens & Sons Company (Pentucket Mills), Haverhill, Mass.

Toupin, Stephane Frederick, VI, '24 (B.T.E.). Surveyor, Canadian National Railways, Land Survey Department, Montreal, Canada.

True, William Clifford, II, '22 (D). Rate Clerk, Chelsea Fibre Mills, Brooklyn, N. Y.

Tyler, Lauriston Whitcombe, II, '16 (D).

Valentine, Burnet, VI, '23 (B.T.E.). Assistant Merchandise Manager, Pacific Mills, 24 Thomas Street, New York City.

Varnum, Arthur Clayton, II, '06 (D). Southbridge, Mass.

Villa, Luis Jorge, IV, '25 (B.T.C.). Medellin, Colombia, S. A.

Villa, William Horace, VI, '24 (B.T.E.). Textile Engineer, Compania Colombiana de Tejidos, Medellin, Colombia, S. A.

Villeneuve, Maurice Arthur, II, '26 (D). With L. Bachmann & Co., Inc., 257 Fourth Avenue, New York City.

Vincent, William Henry, III, '26 (D). Designer, Lancaster Mills, Clinton, Mass.

Walen, Ernest Dean, VI, '14 (B.T.E.). Assistant Agent, Pacific Mills, Lawrence, Mass.

Walker, Alfred Schuyler, II, '11 (D). 67 Park Avenue, Saranac Lake, N. Y.

Walker, Anna Gertrude, IIIb, '03 (C). See Pradel, Mrs. Alois J.

Walker, Raymond Scott, II, '23 (D). Foreman, Mohawk Carpet Mills., Inc., Amsterdam, N. Y.

Wang, Chen, IV, '23 (B.T.C.).

Wang, Cho, VI, '23 (B.T.E.).

Wang, Tung Chuan, VI, '23 (B.T.E.).

Wang, Yung Chi, II, '21 (D). Factory Manager, Ching Yuen Silk Weaving Factory, Shanghai, China.

Warren, Philip Hamilton, II, '05 (D). Superintendent, Hopeville Manufacturing Company, Worcester, Mass.

Washburn, John Milton, Jr., IV, '21 (B.T.C.). Salesman and Demonstrator, National Aniline and Chemical Company, Inc., 27 Lewis Wharf, Boston, Mass.

Watson, William, III, '11 (D). Real Estate, Frank E. Watson, 25 Washington Square, Haverhill, Mass.

Webb, Frank Herbert, IV, '04 (D). Died March 20, 1919.

Webber, Arthur Hammond, IV, '01 (D). Chemist and Demonstrator, Melville Color Company, 93 High Street, Boston, Mass.

Webster, Joseph Albert, VI, '23 (B.T.E.). Industrial Engineer, Aberfoyle Manufacturing Company, Chester, Pa.

Weinstein, Edward Joseph, VI, '25 (B.T.E.). 197 Fremont Street, Harrison, N. J.

Weinz, William Elliot, IV, '08 (D). Salesman, General Dyestuff Corporation, 111 Arch Street, Philadelphia, Pa.

Wells, Ai Edwin, VI, '20 (B.T.E.). Instructor, Electrical Engineering, Lowell Textile School, Lowell, Mass.

Wheaton, Walter Francis, VI, '23 (B.T.E.). Sales Engineer, American Radiator Company, 5335 Belfield Avenue, Philadelphia, Pa.

Wheelock, Stanley Herbert, II, '05 (D) President and Treasurer, Stanley Woolen Company, Uxbridge, Mass.

Whitcomb, Roscoe Myron, IV, '10 (D). Pharmacist, R. M. Whitcomb, Ashland, N. H.

White, Royal Phillip, II, '04 (D). Agent, Stirling Mills, Lowell, Mass.

Whitehill, Warren Hall, IV, '12 (D). Chemist, Talbot Mills, North Billerica, Mass.

Wightman, William Henry, IV, '06 (D). Salesman, Ciba Company, Inc., 157 Federal Street, Boston, Mass.

Wilcox, Leonard Edward, VI, '24 (B.T.E.).

Williamson, Douglas Franklin, I, '22 (D). Superintendent, American Net and Twine Company, Blue Mountain, Ala.

Wilman, Rodney Bernhardt, II, '25 (D). Designer, Amoskeag Mills, Manchester, N. H.

Wilson, John Sigmund, II, '03 (D). Deceased.

Wilson, Walter Ernest Hudson, I, '04 (C). Deceased.

Wing, Charles True, III, '02 (D). Designer, Merrimack Woolen Corporation, Dracut, Mass.

Wingate, William Henry, IV, '08 (D). Color Technician, National Spun Silk Company, New Bedford, Mass.

Wise, Paul Tower, II, '01 (D). Vice-President, Chelsea Fibre Mills, 1155 Manhattan Avenue, Brooklyn, N. Y.

Woo, Tsunkwei, VI, '19,(B.T.E.). Trading and Engineering, China Industrial Supply Company, Shanghai, China.

Wood, Ernest Hadley, S.B., IV, '11 (D).

Wood, Herbert Charles, I, '06 (D). Assistant Superintendent, Union Wadding Company, Pawtucket, R. I.

Wood, James Carleton, IV, '09 (D). Sales Representative, R. T. Vanderbilt Company, New York City.

Wood, Lawrence Burnham, IV, '17 (B.T.C.). Chemist, Lowell Bleachery, Lowell, Mass.

Woodcock, Eugene Close, II, '07 (D). Mill Agent, Chelsea Fibre Mills, 1155 Manhattan Avenue, Brooklyn, N. Y.

Woodhead, Joseph Arthur, VI, '23 (B.T.E.). Textile Testing Expert, United States Testing Company, 316 Hudson Street, New York City.

Woodies, Ida Alberta, IIIb, '00 (C). See Shananquet, Mrs. Lee.

Woodman, Harry Lincoln, I, '02 (C). Draftsman, Merrimac Chemical Company, Woburn, Mass.

Woodruff, Charles Beauregard, I, '06 (C). Secretary and Buyer, Millsap-Woodruff Company, Inc., Birmingham, Ala.

Worthen, Clifford Tasker, IV, '22 (B.T.C.). Overseer, Dyeing and Bleaching, McLoughlin Textile Corporation, 203 Park Avenue, Utica, N. Y.

Wotkowicz, Michael Joseph, VI, '20 (B.T.E.).

Wright, Edward, II, '05 (C). Assistant Engineer, State Board of Health, 141 State House, Boston, Mass.

Wu, Clarence Wen-Lon, VI, '25 (B.T.E.).

Wu, Tsung-Chieh, VI, '25 (B.T.E.).

Yavner, Harry, II, '12 (D). Proprietor, Mayo's Hardware Company, Jamaica Plain, Mass.

Ziock, LeRoy, II, '25 (D). Assistant Superintendent, Rockford Mitten and Hosiery Company, Rockford, Ill.

Zisman, Louis Samuel, IV, '20 (B.T.C.). Head of Dyeing Department, and Chief Chemist, Gotham Silk Hosiery Company, Inc., 401 East 33d Street New York City.

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THE TEXTILE ENGINEER—HIS TRAINING AND OPPORTUNITIES

By HERBERT J. BALL, S.B., B.C.S., *Professor of Textile Engineering*

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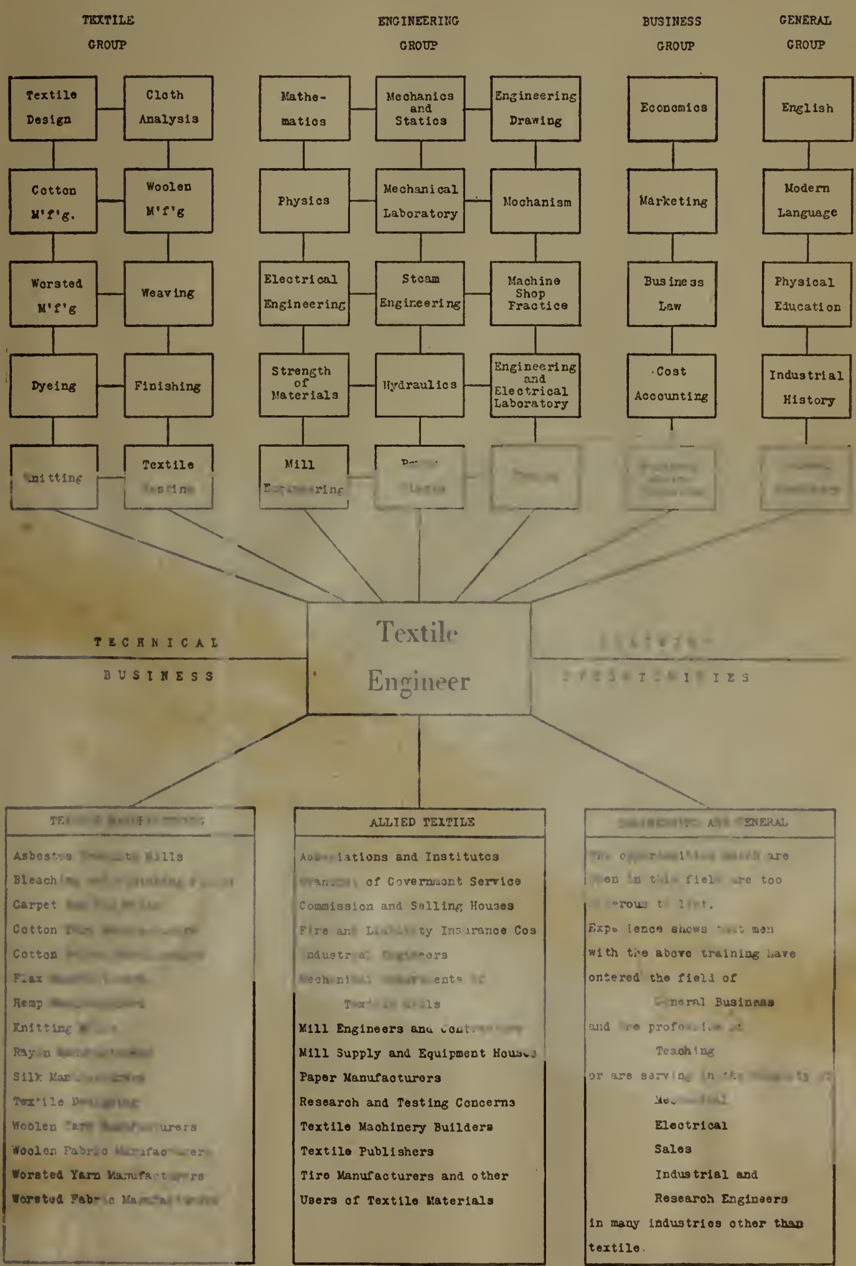
This is the age of the technically trained man in industry and business. One has only to review the changes and progress which have been recorded since the opening year of this century to realize most forcefully the full purport of this statement. What a remarkable array of outstanding achievements this calls to mind. Space does not permit a complete chronicle of them but a few of the major accomplishments in our basic industries must be mentioned.

In the field of communication these years have brought greater perfection of the telephone and telegraph, the development and widely spreading use of the radio, the transoceanic radio telephone, and now television. Improved designs of the internal combustion engine have radically changed our conception of distance, time and space and today we find the gasoline engine harnessed to supply power not only for innumerable purposes in industry and agriculture, but for transportation by land, water and air. Turning to other means of generating power, this same period has witnessed such changes in the design, size and efficiency of power plants, steam and hydraulic, that the lowered cost of electricity has enormously broadened its use and made it indispensable in the home as well as the factory. Those who are familiar with the intimate details of manufacturing processes in every line, could tell of the methods, instruments and machines which have been developed whereby a degree of control over those processes and their products has been obtained more scientific, more exact and far finer than was ever known before. And in the field of distribution and in the realm of management who is not aware of those fundamental changes which are now taking place because of the application of the same scientific principles and methods to the solution of the problems peculiar to these phases of business?

So one might continue to cite innumerable illustrations of a similar sort if that were the purpose of this paper; but it is not. Merely enough of well known outstanding facts have been mentioned to show clearly the invaluable part which science, and engineering in particular, has contributed to this period of progress.

What are the fundamental motives which underlie the constant demand for progress? And upon whom does the solution of the consequent problems fall? The answer to these questions should be given thoughtful attention by every young man who in these days is making preparation for his business career. The very laudable desire to render greater service, the ever-present and powerful urge of competition, the impelling and practical necessity for lowering costs of production, the development of new uses for a product or of new sources of raw materials, and the economic advantages of standardization or of substitution are just a few of the closely intertwined motives which are constantly forcing changes upon every industry. It is to the technically trained man, the man with an engineering and scientific background, that industry today is turning for assistance in solving the complex problems

CHART SHOWING
THE TECHNICAL TRAINING AND BUSINESS OPPORTUNITIES
OF A
TEXTILE ENGINEER



that are continually arising. The textile industry is no exception to this rule of progress, and, although at first it was somewhat slower than other industries to appreciate and use the services of such men, it has now come to recognize the full worth of the Textile Engineer.

Who is a Textile Engineer, and wherein does his equipment differ from that of anyone else, are questions which may well be asked. A Textile Engineer is one whose basic training has been in engineering and the fundamental sciences upon which it rests, but to which has been added a very thorough knowledge and understanding of the raw materials, processes and machines peculiar to textile manufacturing. It is this equipment which causes him to approach textile problems from the scientific standpoint, and to decide them, not on a rule-of-thumb or empirical basis, but upon the basis of clearly established laws, facts and principles. And should the required data be missing or incomplete, his analytically trained mind and his knowledge of methods of research will disclose where or how the gap may be filled. This contribution which he brings to the industry furnishes the scientific foundation upon which its future advancement and progress rests, and is a very similar contribution to that which other engineers with different designations are making to their respective fields of industry, art and science.

The young man who is desirous of obtaining the training requisite for a Textile Engineer, can hardly hope to acquire it solely by mill experience. This process is a long and tedious one at best and even then there is no assurance of its continuity nor that at the completion of the apprentice period the desired results will have been attained. Since industry today has come to recognize the college as the training school for its future executives, it would seem therefore that he should turn to the textile school or college where prescribed courses of study may be found which embody these requisites. By pursuing here a four-year course of study, following a high school education, it is possible to secure in the shortest practical time a thorough grounding in the engineering sciences and the textile processes.

The accompanying chart has been prepared to make it easy to visualize the most important elements which should be comprised in the technical training of a Textile Engineer and also to set forth some of his business opportunities. It has been prepared from the curriculum of the Textile Engineering course as now given at the Lowell Textile Institute. It is interesting to know that this course was originally started in response to a very definite demand from the industry for such men. It has been changed and improved since its inception to keep pace with modern demands, and in its present form represents the result of over twenty years of experience. In this period it has grown to be one of the largest at the Institute.

The upper half of the diagram contains a list of most of the subjects, as now given, arranged in certain natural groups, the textile, the engineering, the business and the general group. The space taken up by each is not to be considered in any way as indicative of either the importance of the subject or the time devoted to it. Each one plays the part for which it is intended in the man's training, and in doing so helps to develop his latent abilities, to increase his store of knowledge, and finally to produce a broadly trained Textile Engineer.

The engineering group of studies, which forms the backbone of the course, is the one which provides the knowledge in the fundamental sciences upon which all manufacturing largely rests. They are of great importance further in inculcating systematic and orderly habits of thought, and in developing analytical and reasoning power This group is powerfully supported in its objectives by the textile group, a list of studies comprising the major textile processes and operations and in which are given thorough and technical instruction in the theory and practice of yarn and fabric production. One finds in the modern business establishment of today a highly developed organization with its departmentalization, its fine division of duties and responsibilities, its intimate control of productive activity, and particularly the keen competition among the personnel for positions of honor, power and financial

reward. It would seem that the Textile Engineer who hopes to make a place for himself should at least be aware of those principles by which business is managed and conducted; hence, the inclusion of the business group. By the same token and still further to round out and broaden his viewpoint there are included other subjects in the general group which are deemed essential to the training of the Bachelor of Textile Engineering.

The question as to whether a course of this character is productive of a practical and useful type of engineer who can stand up under the stress of business is answered best by reference to the lower half of the same chart. This is a compilation, which does not pretend to be complete, of the business opportunities which are open to the Textile Engineer. It has been drawn from the actual list of firms which have absorbed the engineering graduates of the Lowell Textile Institute in the past years. A careful, thoughtful study of the list must certainly convince the reader of the remarkable extent of the fields which are open. As has been stated previously this course grew out of an actual demand for men with a technical and textile training and it is interesting to record that the demand has steadily and constantly increased and at the present writing seems to give clear indication of being in excess of the supply.

In the first column under the title of Textile Manufacturing reference will be found to practically every important fiber which is used for the manufacture of yarns and fabrics. In other words the entire textile manufacturing industry finds a use and a need for a Textile Engineer. The methods of manipulation of fibers are all so similar in their general characteristics that a thorough knowledge of the cotton, wool and worsted processes seems to offer such adequate equipment that he can assimilate quickly those lesser differences which he finds in the processing of other fibers. If one will really inquire into the infinitely varied uses, common and unusual, to which textiles are now put, and will realize the enormous quantities which are being consumed daily throughout the world, if one will also remember that the textile industry is rated as the third or fourth largest in our own country, then a better conception will be obtained of the true scope of the opportunities which seem to be stated so briefly under the above heading.

The title, Allied Textile, used for the second column is intended to designate those fields of business activity which do not involve the direct manufacture of textiles but to which a textile knowledge is essential. This huge textile industry must be supplied, for example, with properly designed machinery and equipment, with supplies of almost infinite variety, and with equally numerous services of an indispensable sort. Here also in this list will be found only a mere mention of just a few of those other industries, in themselves large, which use finished textile products as raw materials, but upon the properties and qualities of which rest the success of their own manufacturing processes. The Textile Engineer finds many demands for his services from this Allied Textile field alone.

The third title, Engineering and General, has been used to describe an equally broad classification of business opportunities. The training of the Textile Engineer as described above has proved to be so fundamental that graduates whose final inclinations have been towards engineering rather than textiles have found ample opportunities for their services in strictly engineering lines. This is such a wide field in itself that it is out of the question to attempt to list the possible occupations in this paper. Let it suffice to say that practical experience shows that Textile Engineers have entered the field of general business, the profession of teaching, and are serving in the capacity of mechanical, electrical, sales, industrial and research engineers in many industries other than textile.

Surely Textile Engineering presents an opportunity which should challenge the full capabilities of any young man of latent ability and promise.